Intel® 3210 and 3200 Chipset

Thermal/Mechanical Design Guide

November 2007

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Revision History

Document Number	Revision Number	Description	Date
318465	001	• Initial release of the document.	November 2007

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1 Introduction

As the complexity of computer systems increases, so do the power dissipation requirements. Care must be taken to ensure that the additional power is properly dissipated. Typical methods to improve heat dissipation include selective use of ducting, and/or passive heatsinks.

The goals of this document are to:

- Outline the thermal and mechanical operating limits and specifications for Intel® 3210 and 3200 Chipsets.
- Describe a reference thermal solution that meets the specification of Intel® 3210 and 3200 Chipsets.

Properly designed thermal solutions provide adequate cooling to maintain Intel® 3210 and 3200 Chipsets die temperatures at or below thermal specifications. This is accomplished by providing a low local-ambient temperature, ensuring adequate local airflow, and minimizing the die to local-ambient thermal resistance. By maintaining Intel® 3210 and 3200 Chipsets die temperature at or below the specified limits, a system designer can ensure the proper functionality, performance, and reliability of the chipset. Operation outside the functional limits can degrade system performance and may cause permanent changes in the operating characteristics of the component.

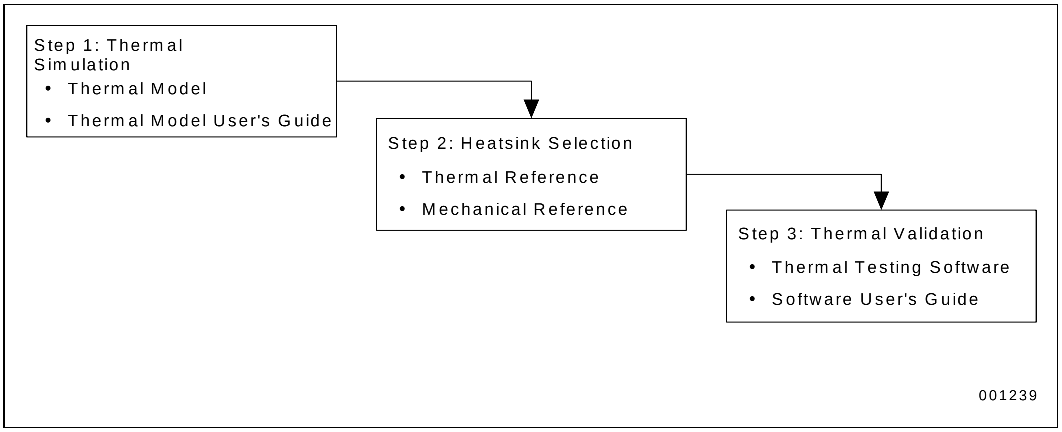
The simplest and most cost-effective method to improve the inherent system cooling characteristics is through careful chassis design and placement of fans, vents, and ducts. When additional cooling is required, component thermal solutions may be implemented in conjunction with system thermal solutions. The size of the fan or heatsink can be varied to balance size and space constraints with acoustic noise.

This document addresses thermal design and specifications for Intel® 3210 and 3200 Chipsets components only. For thermal design information on other chipset components, refer to the respective component datasheet. For the Intel® ICH9, refer to the *Intel® I/O Controller Hub9 (ICH9) Thermal Design Guidelines*.

Note: Unless otherwise specified, the term "MCH" refers to the Intel® 3210 and 3200 Chipsets.

1.1 Design Flow

Figure 1-1. Thermal Design Process



1.2 Definition of Terms

FC-BGA	Flip Chip Ball Grid Array. A package type defined by a plastic substrate where a die is mounted using an underfill C4 (Controlled Collapse Chip Connection) attach style. The primary electrical interface is an array of solder balls attached to the substrate opposite the die. Note that the device arrives at the customer with solder balls attached.
BLT	Bond line thickness. Final settled thickness of the thermal interface material after installation of heatsink.
MCH	Memory controller hub. The chipset component contains the processor interface, the memory interface, the PCI Express* interface and the DMI interface.
ICH	I/O controller hub. The chipset component contains the MCH interface, the SATA interface, the USB interface, the IDE interface, the LPC interface, and so forth.
IHS	Integrated Heat Spreader. A thermally conductive lid integrated into the package to improve heat transfer to a thermal solution through heat spreading.
T_{case_max}	Maximum die or IHS temperature allowed. This temperature is measured at the geometric center of the top of the package die or IHS.
T_{case_min}	Minimum die or IHS temperature allowed. This temperature is measured at the geometric center of the top of the package die or IHS.
TDP	Thermal design power. Thermal solutions should be designed to dissipate this target power level. TDP is not the maximum power that the chipset can dissipate.
TIM	Thermal Interface Material. Thermally conductive material installed between two surfaces to improve heat transfer and reduce interface contact resistance.
T_{LA}	The local ambient air temperature at the component of interest. The local ambient temperature should be measured just

	upstream of airflow for a passive heatsink or at the fan inlet for an active heatsink.
Ψ_{CA}	Case-to-ambient thermal solution characterization parameter (Psi). A measure of thermal solution performance using total package power. Defined as (T_C - T_{LA})/Total Package Power. Heat source size should always be specified for Ψ measurements.

1.3 Reference Documents

The reader of this specification should also be familiar with material and concepts presented in the following documents:

Document Title	Document Number / Location
Intel® I/O Controller Hub9 (ICH9) Thermal Design Guidelines	Contact your Intel Field Sales Representative
Intel® 3210 and 3200 Chipset Datasheet	www.developer.intel.com
Intel® 3210 and 3200 Chipset Specification Update	www.developer.intel.com
Dual-Core Intel® Xeon® Processor 3000 Series Datasheet	www.developer.intel.com
Quad-Core Intel® Xeon® Processor 3200 Series Datasheet	www.developer.intel.com
BGA/OLGA Assembly Development Guide	Contact your Intel Field Sales Representative
Various system thermal design suggestions	http://www.formfactors.org

Note: Contact your Intel field sales representative for the latest revision and order number of this document.

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2 Packaging Technology

The Intel® 3210 and 3200 Chipset consists of two individual components: the Memory Controller Hub (MCH) and the Intel® I/O Controller (Intel® ICH9). The Intel® 3210 and 3200 Chipset MCH component uses a 40 mm [1.57 in] x 40 mm [1.57 in] Flip Chip Ball Grid Array (FC-BGA) package with an integrated heat spreader (IHS) and 1300 solder balls. A mechanical drawing of the package is shown in Figure 2-1. For information on the Intel® ICH9 package, refer to the *Intel® I/O Controller Hub9 (ICH9) Thermal Design Guidelines*.

Figure 2-1. MCH Package Dimensions (Top View)

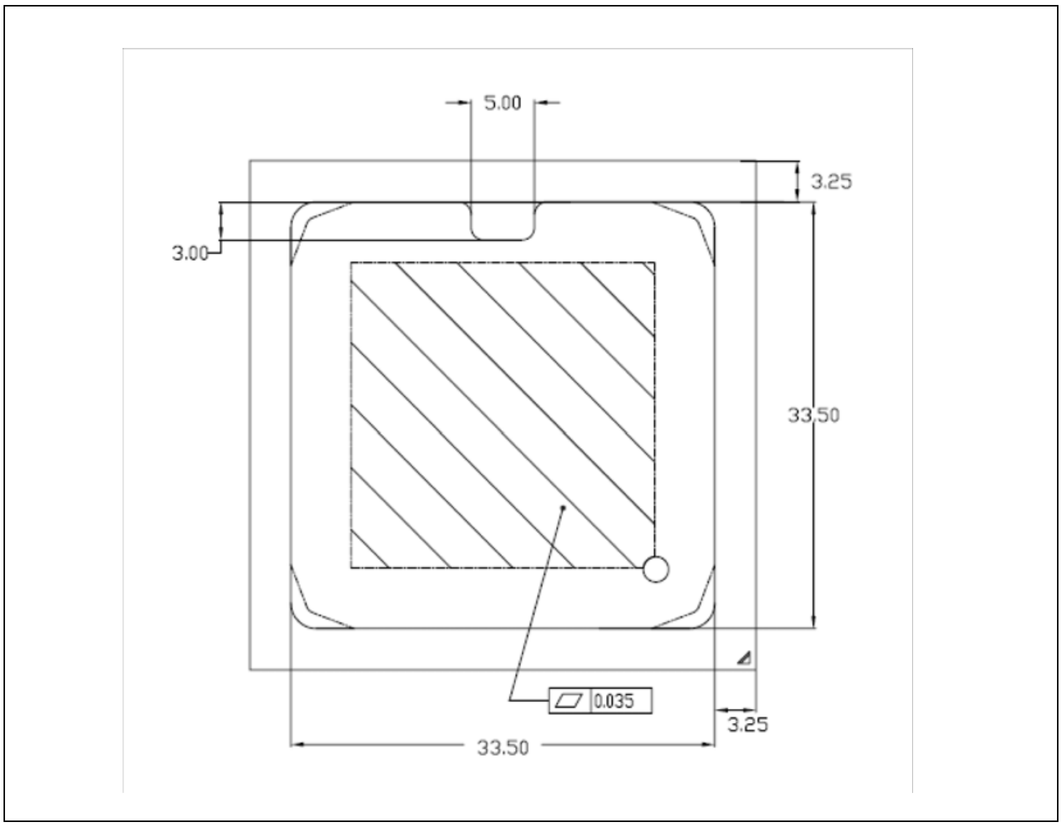


Figure 2-2. MCH Package Height

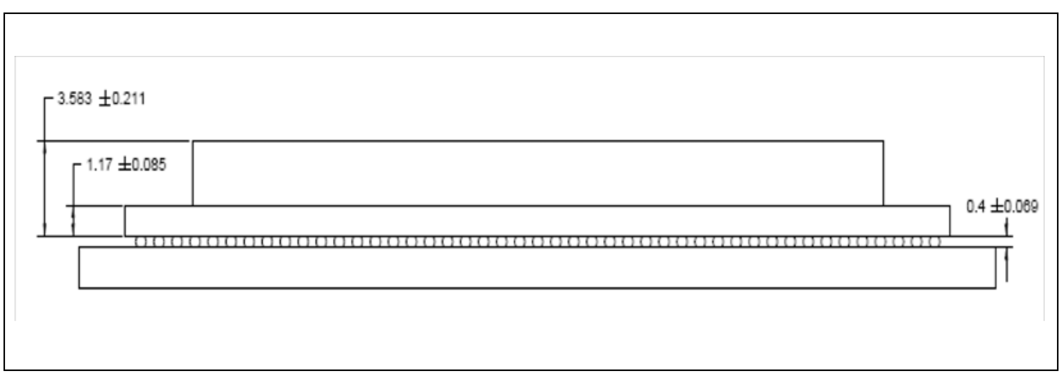
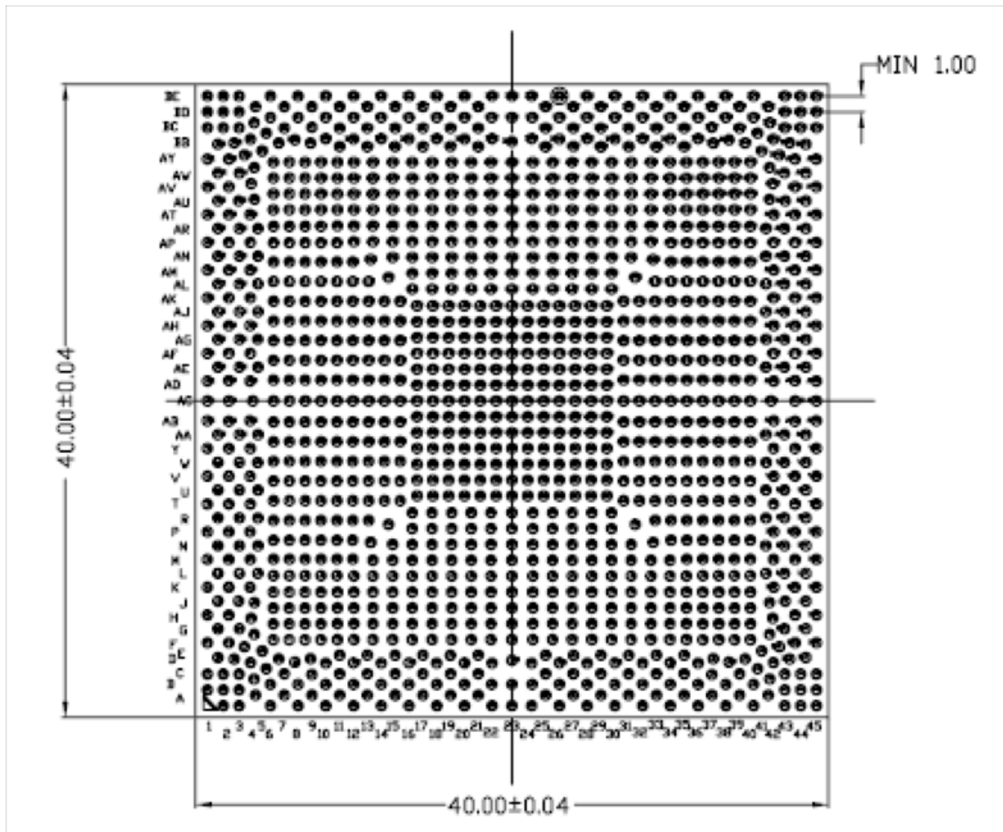


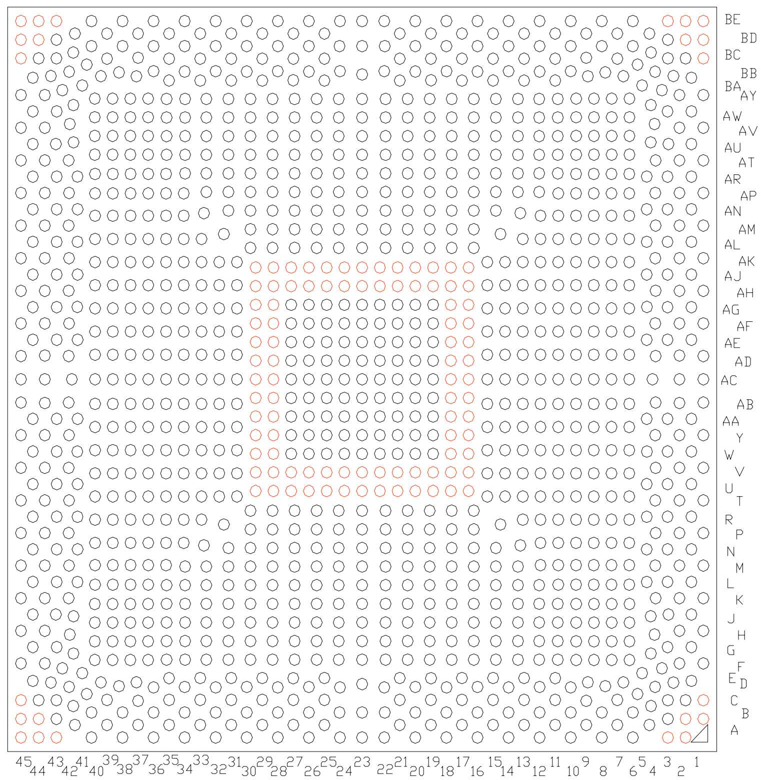
Figure 2-3. MCH Package Dimensions (Bottom View)



Notes:
1. All dimensions are in millimeters.
2. All dimensions and tolerances conform to ANSI Y14.5 - 1994.

2.1 Non-Critical to Function Solder Joints

Figure 2-4. Non-Critical to Function Solder Joints



Intel has defined selected solder joints of the MCH as non-critical to function (NCTF) when evaluating package solder joints post environmental testing. The MCH signals at NCTF locations are typically redundant ground or no-critical reserved, so the loss of the solder joint continuity at end of life conditions will not affect the overall product functionality. Figure 2-4 identifies the NCTF solder joints of the MCH package.

2.2 Package Mechanical Requirements

The Intel® 3210 and 3200 Chipset package has an Integrated Heat Spreader (IHS) which is capable of sustaining a maximum static normal load of 15-lbf. This mechanical maximum load limit should not be exceeded during heatsink assembly, shipping conditions, or standard use conditions. Also, any mechanical system or component testing should not exceed the maximum limit. The package substrate should not be used as a mechanical reference or load-bearing surface for the thermal and mechanical solution.

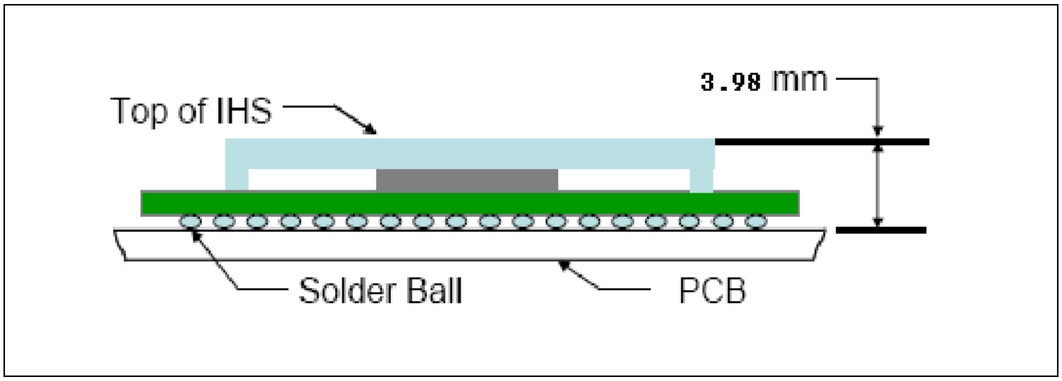
Notes:

1. These specifications apply to uniform compressive loading in a direction normal to the package.

2. This is the maximum force that can be applied by a heatsink retention clip. The clip must also provide the minimum specified load of 7.6 lbf on the package to ensure TIM performance assuming even distribution of the load.
3. These specifications are based on limited testing for design characterization. Loading limits are for the package only.

To ensure that the package static load limit is not exceeded, the designer should understand the post reflow package height shown in Figure 2-5. The following figure shows the nominal post-reflow package height assumed for calculation of a heatsink clip preload of the reference design. Please refer to the package drawing in Figure 2-1 to perform a detailed analysis.

Figure 2-5. Package Height



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3 Thermal Specifications

3.1 Thermal Design Power (TDP)

Analysis indicates that real applications are unlikely to cause the MCH component to consume maximum power dissipation for sustained time periods. Therefore, in order to arrive at a more realistic power level for thermal design purposes, Intel characterizes power consumption based on known platform benchmark applications. The resulting power consumption is referred to as the Thermal Design Power (TDP). TDP is the target power level that the thermal solutions should be designed to. TDP is not the maximum power that the chipset can dissipate.

For TDP specifications, see Table 3-1 for Intel® 3210 Chipset and Table 3-2 for Intel® 3200. FC-BGA packages have poor heat transfer capability into the board and have minimal thermal capability without a thermal solution. Intel recommends that system designers plan for a heatsink when using the Intel® 3210 and 3200 Chipset.

3.2 Thermal Specification

To ensure proper operation and reliability of the Intel® 3210 and 3200 Chipset, the case temperatures must be at or between the maximum/minimum operating temperature ranges as specified in Table 3-1 and Table 3-2. System and/or component level thermal solutions are required to maintain these temperature specifications. Refer to Chapter 5 for guidelines on accurately measuring package die temperatures.

Table 3-1. Intel® 3210 Chipset Thermal Specifications

Parameter	Value	Notes
T_{case_max}	96 °C	
T_{case_min}	5 °C	
$TDP_{dual\ channel}$	20.2 W	DDR2-667
$TDP_{dual\ channel}$	21.3 W	DDR2-800
P_{Idle_max}	11.3 W	

Notes:
1. The above specifications are based on post-si analysis.
2. The maximum idle power is the worst-case idle power with L1 ASPM state.

Table 3-2. Intel® 3200 Chipset Thermal Specifications

Parameter	Value	Notes
T_{case_max}	97 °C	
T_{case_min}	5 °C	
$TDP_{dual\ channel}$	18.9 W	DDR2-667
$TDP_{dual\ channel}$	20.0 W	DDR2-800
P_{Idle_max}	11.3 W	

Notes:
1. The above specifications are based on post-silicon analysis.
2. The maximum idle power is the worst case idle power with L1 ASPM state.

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4 Thermal Simulation

Intel provides thermal simulation models of the Intel® 3210 and 3200 Chipset and associated user's guides to aid system designers in simulating, analyzing, and optimizing their thermal solutions in an integrated, system-level environment. The models are for use with the commercially available Computational Fluid Dynamics (CFD)-based thermal analysis tool FLOTHERM* (version 5.1 or higher) by Flomerics, Inc. Contact your Intel field sales representative for the information of the thermal models and user's guides.

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5 Thermal Metrology

The system designer must make temperature measurements to accurately determine the thermal performance of the system. Intel has established guidelines for proper techniques to measure the MCH IHS temperatures. Section 5.1 provides guidelines on how to accurately measure the MCH case temperature.

5.1 MCH Case Measurement

Intel® 3210 and 3200 Chipset cooling performance is determined by measuring the case temperature using a thermocouple. For case temperature measurements, the attached method outlined in this section is recommended for mounting a thermocouple.

Special case is required when measuring case temperature (Tc) to ensure an accurate temperature measurement. Thermocouples are often used to measure Tc. When measuring the temperature of a surface that is at a different temperature from the surrounding local ambient air, errors may be introduced in the measurements. The measurement errors can be caused by poor thermal contact between the thermocouple junction and the surface of the integrated heat spreader, heat loss by radiation, convection, by conduction through thermocouple leads, or by contact between the thermocouple cement and the heatsink base. To minimize these measurement errors, the approach outlined in the next section is recommended.

5.1.1 Supporting Test Equipment

To apply the reference thermocouple attach procedure, it is recommended that you use the equipment (or equivalent) given in Table 5-1.

Table 5-1. Thermocouple Attach Support Equipment (Sheet 1 of 2)

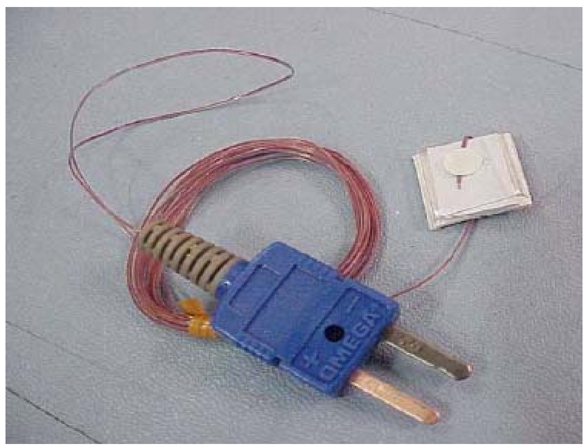
Item	Description	Part Number
	Measurement and Output	
Microscope	Olympus* Light microscope or equivalent	SZ-40
DMM	Digital Multi Meter for resistance measurement	Fluke 79 Series
Thermal Meter	Hand held thermocouple meter	Multiple Vendors
	Test Fixtures (see notes for ordering information)	
Special Modified Tip Solder Block Fixture	40 W 120 V~60 Hz modified soldering iron	Weller SP40L solder tool
	Miscellaneous Hardware (see notes for ordering information)	
Solder	Indium Corp. of America Alloy 57BI/42SN/1AG 0.010 Diameter	52124
Flux	Indium Corp. of America	5RMA
Loctite* 498 Adhesive	Super glue w/ thermal characteristics	49850
Adhesive Accelerator	Loctite 7452 for fast glue curing	18490
Kapton* Tape	for holding thermocouple in place	
Thermocouple	Omega*, 36 gauge, T type (see note 2 for ordering information)	OSK2K1280/5SR TC-TT-T-36-72

Table 5-1. Thermocouple Attach Support Equipment (Sheet 2 of 2)

Item	Description	Part Number
Calibration and Control		
Ice Point Cell	Omega, stable 0°C temperature source for calibration and offset	TRCIII
Hot Point Celll	Omega, temperature source to control and understand meter slope gain	CL950-A-110

Notes:
1. The Special Modified Tip Solder Block Fixture is available from Test Equipment Depot 800-517-8431.
2. The Alloy 57BI/42SN/1AG 0.010 Diameter solder and the solder flux are available from Indium Corp. of America 315-853-4900.
3. The Loctite* 498 Adhesive and Adhesive Accelerator are available from R.S. Hughes 916-737-7484.
4. This part number is a custom part with the specified insulation trimming and packaging requirements necessary for quality thermocouple attachment, See Figure 16. Order from Omega Eng +1-800-826-6342.

Figure 5-1. Omega Thermocouple



5.1.2 Thermal Calibration and Controls

It is recommended that full and routine calibration of temperature measurement equipment be performed before attempting to perform case temperature measurements. Intel recommends checking the meter probe set against know standard. This should be done at 0 °C (using ice bath or other stable temperature source) and at an elevated temperature, around 80 °C (using an appropriate temperature source).

Wire gauge and length should also be considered, as some less expensive measurement systems are heavily impacted by impedance. There are numerous resources available throughout the industry to assist with implementation of proper controls for thermal measurements.

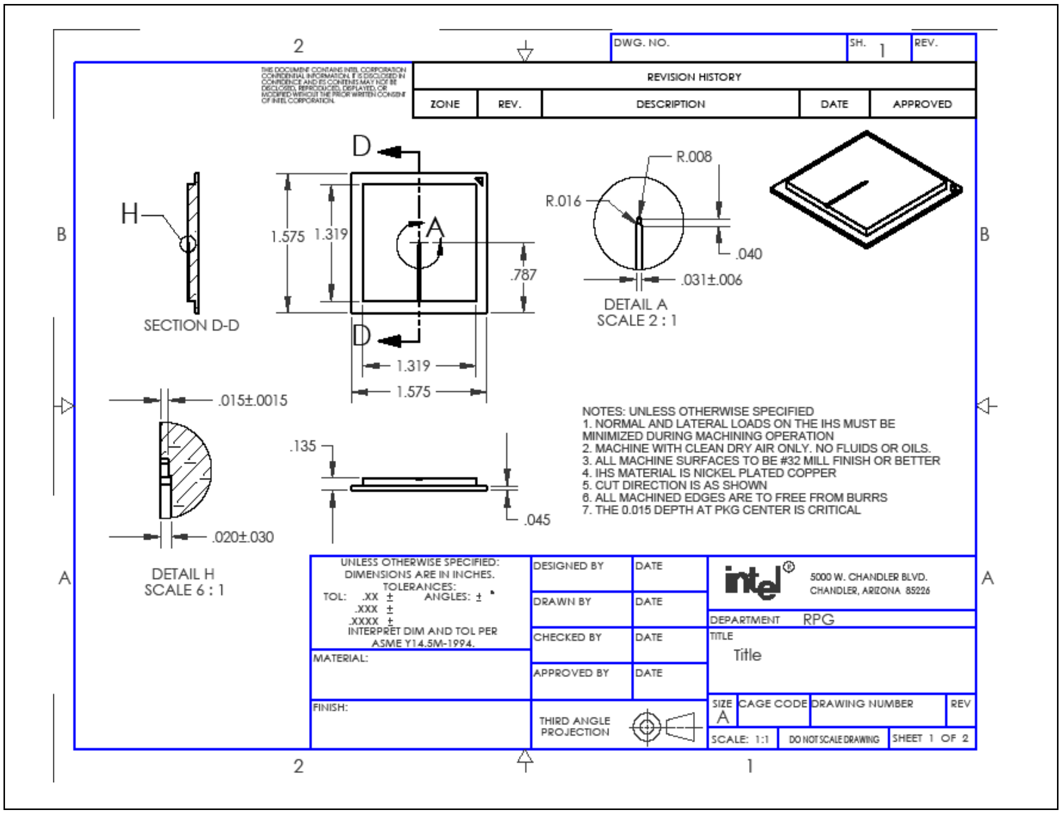
Note: 1. It is recommended to follow company-standard procedures and wear safety items like glasses for cutting the IHS and gloves for chemical handling.

2. Please ask your Intel field sales representative if you need assistance to groove and/or install a thermocouple according to the reference process.

5.1.3 IHS Groove

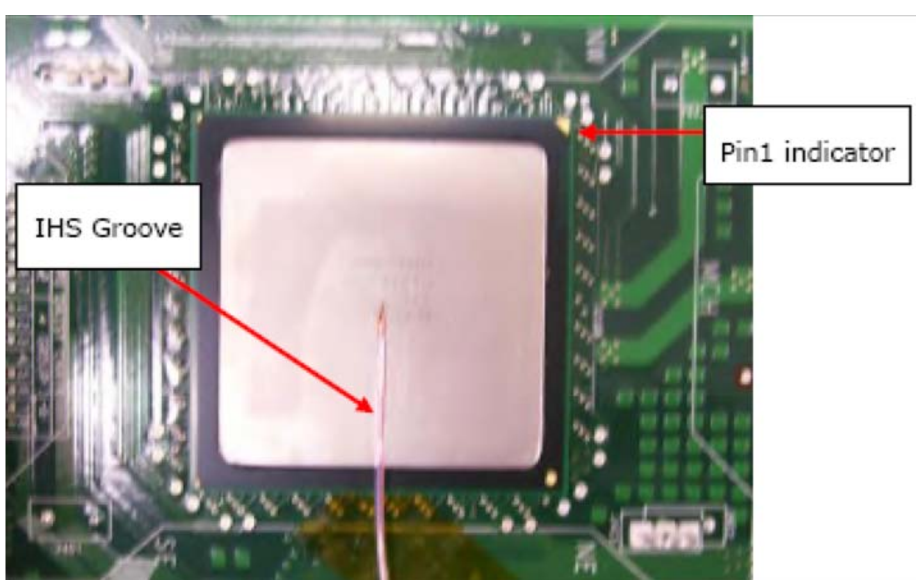
Cut a groove in the package IHS according to the drawing given in Figure 5-2.

Figure 5-2. FCBGA7 Chipset Package Reference Groove Drawing



The orientation of the groove relative to the package pin 1 indicator (gold triangle in one corner of the package) is shown in Figure 5-3 for the FCBGA7 chipset package IHS.

Figure 5-3. IHS Groove on the FCBGA7 Chipset Package on the Live Board



Select a machine shop that is capable of holding drawing-specified tolerances. IHS groove geometry is critical for repeatable placement of the thermocouple bead, ensuring precise thermal measurements. A fixture plate should be used to machine the IHS groove on the FCBGA7 Chipset Package on the Live Board. Refer to Figure 5-4.

Figure 5-4. The Live Board on the Fixture Plate

5.1.4 Thermocouple Attach Procedure

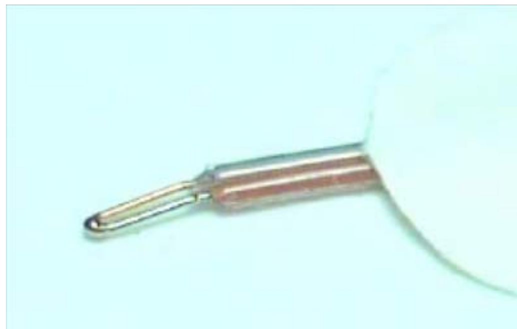
In order to accomplish the thermocouple attach procedure, the following steps are required:

1. Thermocouple conditioning and preparation
2. Thermocouple attach to the IHS
3. Soldering process
4. Cleaning and completion of the thermocouple installation

5.1.4.1 Thermocouple Conditioning and Preparation

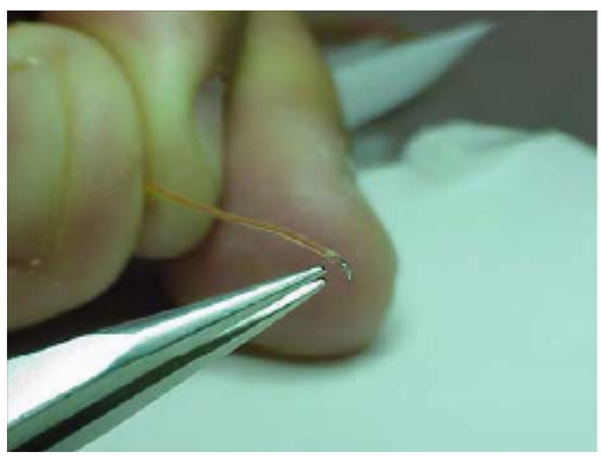
1. Use a calibrated thermocouple, as specified in Section 5.1.3.
2. Under a microscope verify the thermocouple insulation meets the quality requirements. The insulation should be about 1/16 inch (0.062 ± 0.030) from the end of the bead. Refer to Figure 5-5.

Figure 5-5. Inspection of Insulation on Thermocouple



3. Measure the thermocouple resistance by holding both contacts on the connector on one probe and the tip of thermocouple to the other probe of the DMM (measurement should be about ~3.0 ohms for 36-gauge type T thermocouple).
4. Straighten the wire for about 38 mm [1.5 inch] from the bead.
5. Using the microscope and tweezers, bend the tip of the thermocouple at approximately 10 degree angle by about 0.8 mm [.030 inch] from the tip. Refer to Figure 5-6.

Figure 5-6. Bending the Tip of the Thermocouple



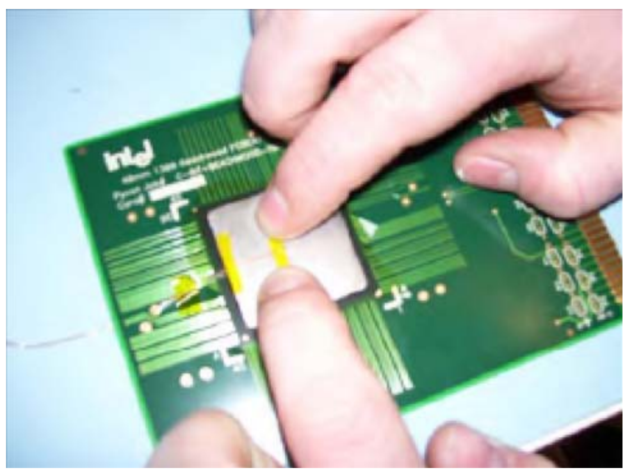
5.1.4.2 Thermocouple attach to the IHS

6. Clean groove and IHS with Isopropyl Alcohol (IPA) and a lint free cloth removing all residues prior to thermocouple attachment.
7. Place the Thermocouple wire inside the groove and let the exposed wire extend slightly over the end of groove. Refer to Figure 5-7.

Figure 5-7. Extending Slightly the Exposed Wire over the End of Groove

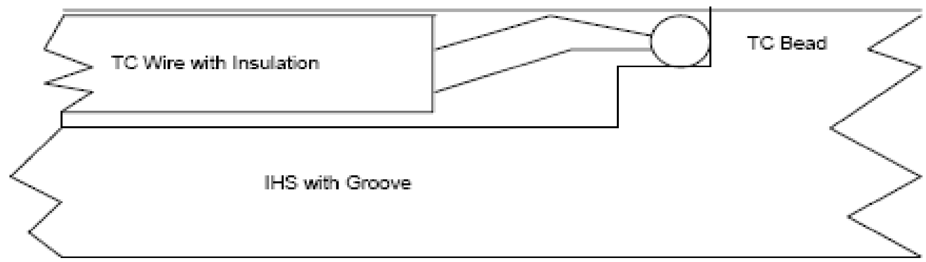
8. Bend the wire at the edge of the IHS groove and secure it in place using Kapton* tape. Refer to Figure 5-8.

Figure 5-8. Securing Thermocouple Wire with Kapton* Tape Prior to Attach



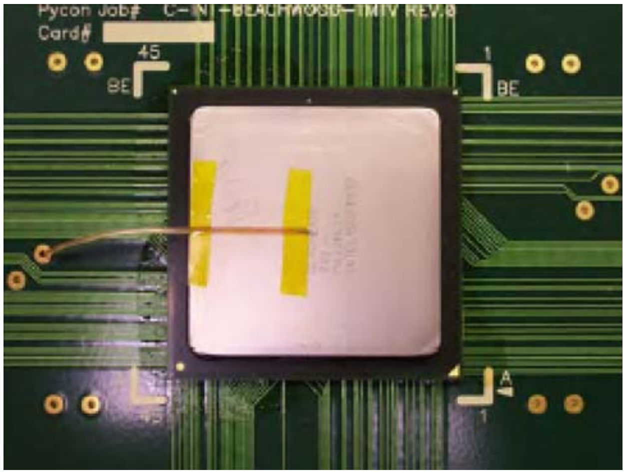
9. Verify under the microscope that the Thermocouple bead is still slightly bent, if not, use a fine point tweezers to put a slight bend on the tip. The purpose of this step is to ensure that the Thermocouple tip is in contact with the bottom of groove. Refer to Figure 5-9.

Figure 5-9. Detailed Thermocouple Bead Placement



10. Place the device under the microscope to continue with the process.
11. Using tweezers or a finger, slightly press the wire down inside the groove for about 5 mm from tip and place small piece of Kapton* tape to hold the wire inside the groove. Refer to Figure 5-10.

Figure 5-10. Tapes Installation

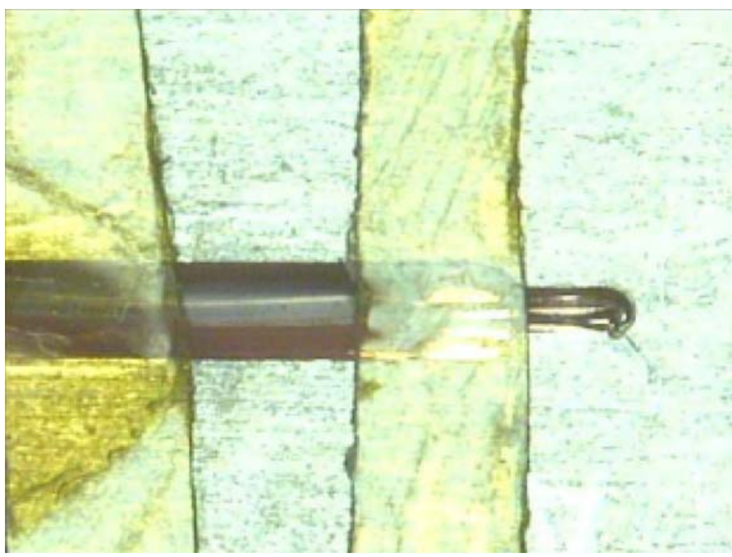


12. Thermocouple bead is placed into the bottom of the groove (Refer to Figure 5-11) and a small piece of tape is installed to secure it under the microscope to perform this task.

Figure 5-11. Placing Thermocouple Bead into the Bottom of the Groove

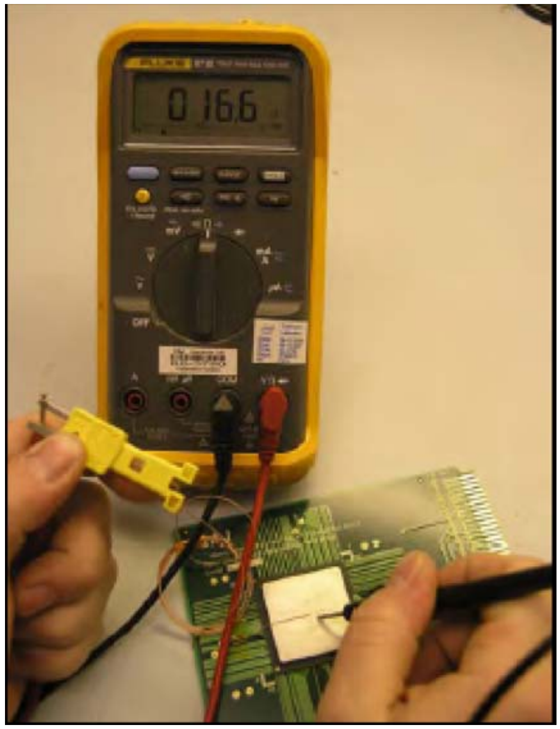
13. Place a second small piece of Kapton* tape on top of the IHS where it narrows at the tip. This tape will create a solder dam and keep solder from flowing down the IHS groove during the melting process. Refer to Figure 5-12.

Figure 5-12. Second Tape Installation



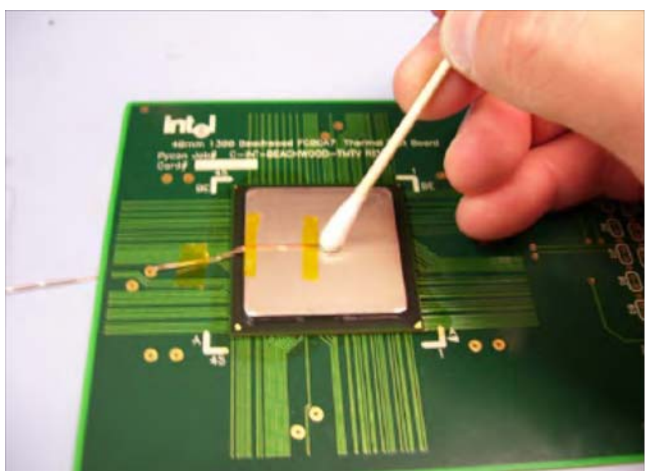
14. Measure resistance from the Thermocouple connector (hold both wires to a DMM probe) to the IHS surface, this should display the same value as read during Thermocouple conditioning Section 5.1.4.1 step 3. This step insures the bead is still making good contact to the IHS. Refer to Figure 5-13.

Figure 5-13. Measuring Resistance between Thermocouple and IHS



15. Using a fine-point device such as a toothpick, place a small amount of Indium paste flux on the Thermocouple bead. Refer to Figure 5-14.

Figure 5-14. Adding a Small Amount of Past Flux to the Bead for Soldering



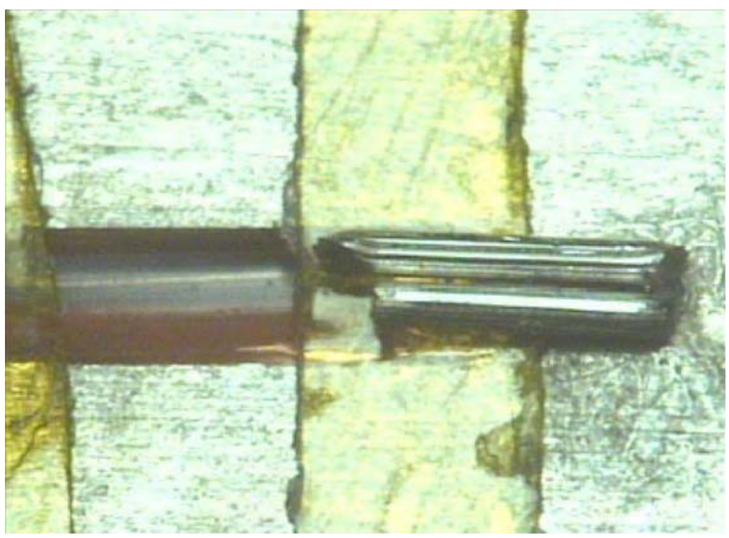
Note: Make sure you are careful to keep solder flux from spreading on the IHS surface or down the groove. It should be contained to the bead area and only the tip (narrow section of the groove). This will keep the solder from flowing onto the top of the device or down the groove to the insulation area.

16. Cut two small pieces of solder 1/16 inch (0.065 inch/ 1.5 mm) from the roll using tweezers to hold the solder while cutting with a fine blade. Refer to Figure 5-15.

Figure 5-15. Cutting Solder

17. Place the two pieces of solder in parallel, directly over the thermocouple bead. Refer to Figure 5-16.

Figure 5-16. Positioning Solder on IHS



18. Measure the resistance from the thermocouple end wires again using the DMM (Refer to Section 5.1.4.1 step 3) to ensure that the bead is still properly contacting the IHS.

5.1.4.3 Solder Process

19. Turn on the Solder Block station and heat it up to 170 °C±5 °C.

Note: The heater block temperature must be set at a greater temperature to ensure that the solder on the IHS can reach 150 °C - 155 °C. Make sure to monitor the Thermocouple meter when waiting for solder to flow. Damage to the package may occur if a temperature of 155 °C is exceeded on the IHS.

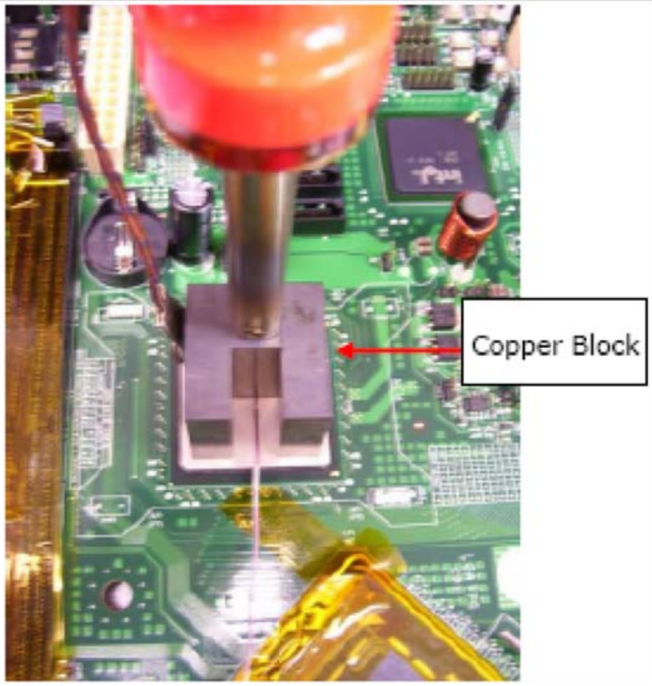
20. Attach the tip of the thermocouple to the solder block (perform this before turning on the solder station switch) and connect to a Thermocouple meter to monitor the temperature of the block. Refer to Figure 5-17.
21. Connect (Thermocouple being installed) to a second thermocouple meter to monitor the IHS temperature and make sure this doesn't exceed 155 °C at any time during the process. Refer to Figure 5-17.

Figure 5-17. Solder Block Setup

Note: Device in place; Two temperature monitoring meters; Heater block fixture. The heater block is currently reading 157 °C and the Thermocouple inside IHS is reading 23 °C.

22. Place the solder fixture on the IHS device. Refer to Figure 5-18.

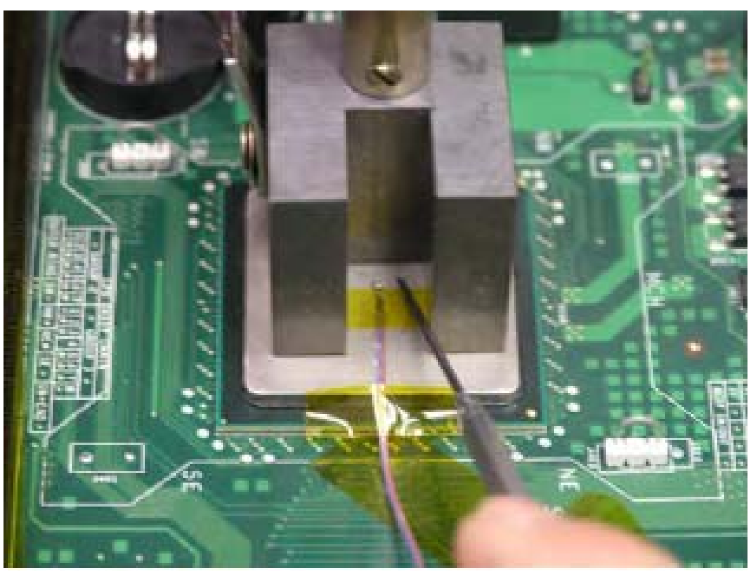
Figure 5-18. Observing the Solder Melting



Note: Do not touch the copper block at any time as it is hot.

23. Move a magnified lens light close to the device to get a better view when the solder starts melting. Manually assist this if necessary as the solder sometimes tends to move away from the end of the groove. Use fine tip tweezers to push solder into the end of groove until a solder ball is built up. Refer to Figure 5-19.

Figure 5-19. Pushing Solder Back into the End of Groove



Note: The target IHS temperature during reflow is 150°C ±3°C. At no time should the IHS temperature exceed 155 °C during the solder process as damage to the device may occur.

24. Lift the solder block and magnified lens, quickly rotate the device 90 degrees clockwise and use the back side of the tweezers to press down on the solder. This will force out excess solder. Refer to Figure 5-20.

Figure 5-20. Remove Excess Solder

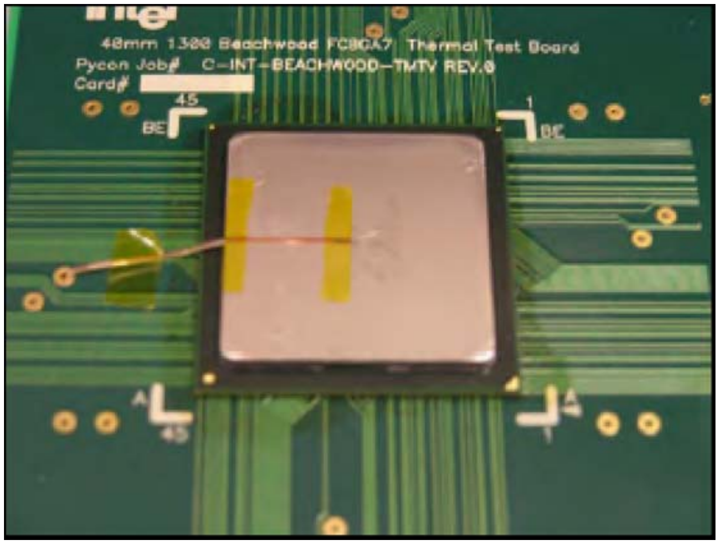
25. Allow the device to cool down. Blowing compressed air on the device can accelerate the cooling time. Monitor the device IHS temperature with a handheld meter until it drops below 70 °C before moving it to the microscope for the final steps.

5.1.4.4 Cleaning and Completion of Thermocouple Installation

26. Remove the Kapton* tape with tweezers (avoid damaging the wire insulation) and straighten the wire to insert the remaining portion in the groove for the final gluing process.

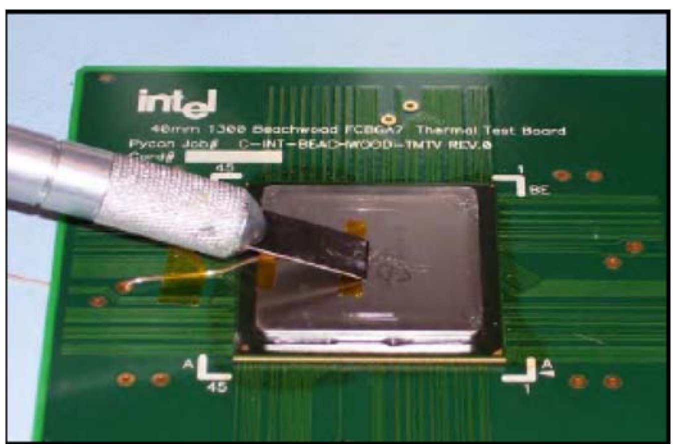
Note: The wire needs to be straighten in order to keep it at or below the IHS surface. Refer to Figure 5-21.

Figure 5-21. Thermocouple Placed into Groove



27. Using a blade, carefully shave the excess solder above the IHS surface. Only shave in one direction until solder is flush with the groove surface. Refer to Figure 5-22.

Figure 5-22. Remove Excess Solder

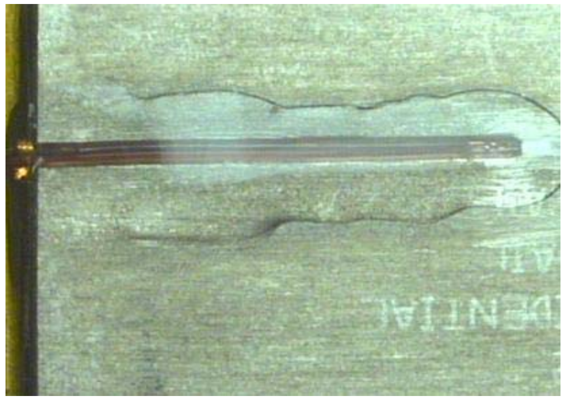


Notes:
1. Always insure tools are very sharp and free from any burrs that may scratch the IHS surface. It is a good practice to minimize any surface scratching or other damage during this process.
2. Shaving excess solder to insure the IHS surface is flat and will mate properly with the heatsink surface. Scratches and protrusions may impact the thermal transfer from IHS.

28. Clean the surface of the IHS with Alcohol and wipes, use compressed air to remove any remaining contaminants.

29. Fill the test of the groove with Loctite* 498 Adhesive. Verify under the microscope that the Thermocouple wire is below the surface along the entire IHS groove. Refer to Figure 5-23.

Figure 5-23. Fill Groove with Adhesive



30. To speed up the curing process apply Loctite* Accelerator on top of the Adhesive and let it set for a couple of minutes.
31. Using a blade carefully shave any Loctite* left above the IHS surface; take into consideration instructions from step 27.

Note: The adhesive shaving process should be performed when the glue is partially cured but still soft (about 1 hour after applying). This will keep the adhesive surface flat and smooth with no pits or voids. If you have void areas in the groove, refill them and shave the surface a second time.

32. Clean the IHS surface with Alcohol and keep the Thermocouple wire properly managed to avoid insulation damage kinks and tangling.
33. Once again, measure resistance from the Thermocouple connector (hold both wires to a DMM probe) to the IHS surface, this should display the same value as read during Thermocouple conditioning Section xxx. This step insures the bead is still making good contact to the IHS after attachment is complete.
34. Wind the thermocouple wire into loops and now it's ready to be used for thermal testing use. Refer to Figure 5-24.

Figure 5-24. Finished Thermocouple Installation

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6 Reference Thermal Solution

The design strategy of the reference thermal solution for the Intel® 3210 and 3200 Chipset uses backing plate stiffness/design to show significant improvement in MB strain and BGA forces. The thermal interface material and extrusion design requirements are being evaluated for changes necessary to meet the Intel® 3210 and 3200 Chipset thermal requirements. The Keep Out Zone (KOZ) will have the requirements of heatsink mounting hole with Intel® 3210 and 3200 Chipset. Refer to Figure B-2 and Figure B-3 for details. Other chipset components may or may not need attached thermal solutions, depending on the specific system local-ambient operating conditions. For information on the Intel® ICH9, refer to thermal specification in the *Intel® I/O Controller Hub9 (ICH9) Thermal Design Guidelines*.

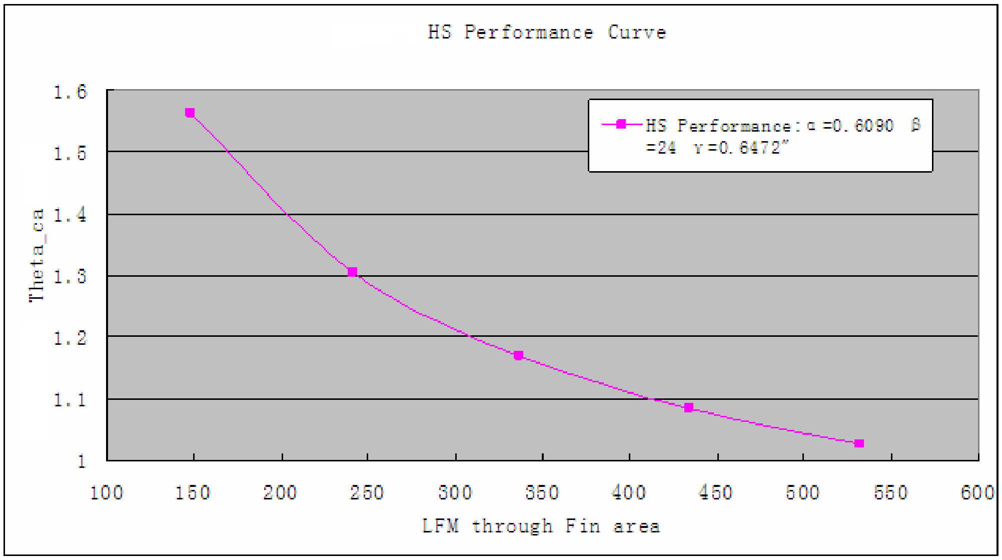
6.1 Operating Environment

The reference thermal solution will be designed assuming a maximum local-ambient temperature of 55 °C. The minimum recommended airflow velocity through the cross-section of the heatsink fins is 350 linear feet per minute (lfm) for 1U system and 450 linear feet per minute (lfm) for 2U+ system. The approaching airflow temperature is assumed to be equal to the local-ambient temperature. The thermal designer must carefully select the location to measure airflow to obtain an accurate estimate. These local-ambient conditions are based on a 35 °C external-ambient temperature at sea level. (External-ambient refers to the environment external to the system.)

6.2 Heatsink Performance

Figure 6-1 depicts the measured thermal performance of the reference thermal solution versus approach air velocity. Since this data was measured at sea level, a correction factor would be required to estimate thermal performance at other altitudes.

Figure 6-1. Reference Heatsink Measured Thermal Performance vs. Approach Velocity



6.3 Mechanical Design Envelope

While each design may have unique mechanical volume and height restrictions or implementation requirements, the height, width, and depth constrains typically placed on the Intel® 3210 and 3200 Chipset thermal solution are shown in Appendix B.

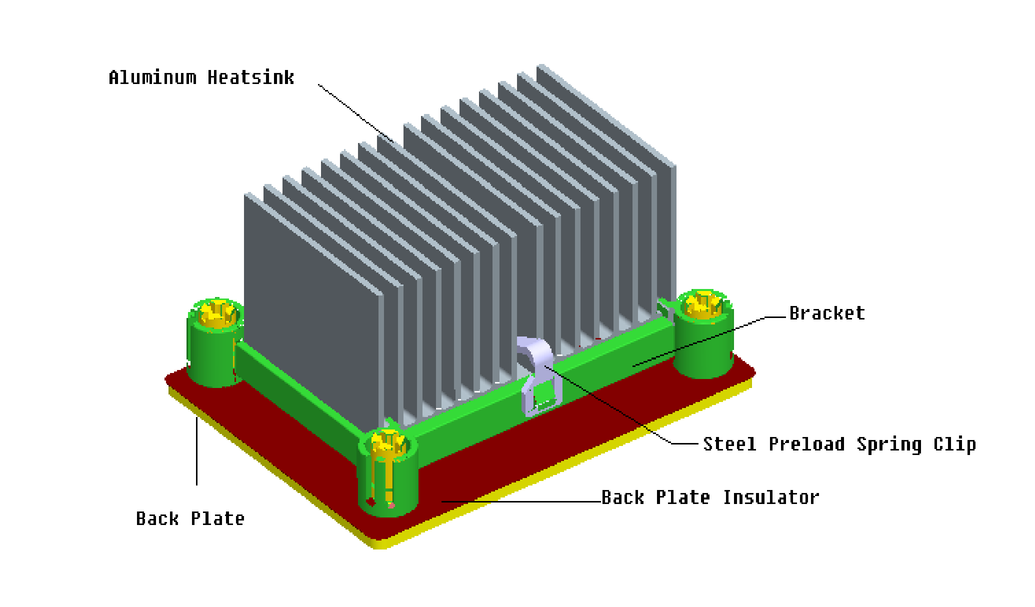
The location of hole patens and keepout zones for the reference thermal solution are shown in Figure B-2 and Figure B-3.

6.4 Thermal Solution Assembly

The reference thermal solution for the Intel® 3210 and 3200 Chipset is a passive extruded heatsink with thermal interface. Figure 6-2 shows the reference thermal solution assembly and associated components.

Full mechanical drawings of the thermal solution assembly and the heatsink are provided in Appendix B.

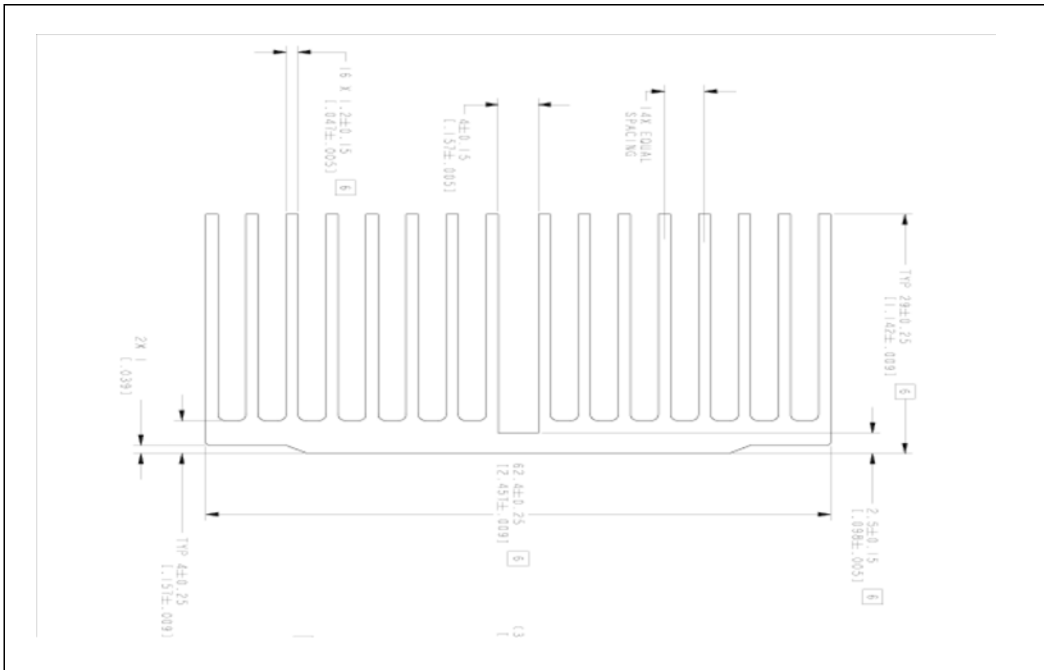
Figure 6-2. Design Concept for Reference Thermal Solution



6.4.1 Extruded Heatsink Profiles

The reference thermal solution uses an extruded heatsink for cooling the chipset MCH. Figure 6-3 shows the heatsink profile. Other heatsinks with similar dimensions and increased thermal performance may be available. A full mechanical drawing of this heatsink is provided in Appendix B.

Figure 6-3. Heatsink Extrusion Profiles



6.4.2 Retention Mechanism Responding in Shock and Vibration

The lead-free process, large package and Integrated Heat Spreader (IHS) application on the Intel® 3210 and 3200 Chipset changed the mechanical responses during shock and vibration comparing with the legacy generation MCH chipset.

The Intel reference thermal solution uses a back plate design that adequately protects the Solder Ball Joint Reliability (SBJR) of the Intel® 3210 and 3200 Chipset. Analysis data indicates that the back plate design provides measurable improvement in SBJR of the Intel® 3210 and 3200 Chipset in ATX form factors (1U ATX-like system is included) where processor heatsink is attached to the motherboard. Hence, Intel recommends using the back plate design on chipset heatsink in such a circumstance to protect the SBJR.

For customized form factors where the processor heatsink is Direct Chassis Attach (DCA), customers are recommended to do shock and vibration analysis and test to determine whether a back plate design is needed or not, which probably will benefit the customer in controlling the heatsink cost.

6.4.3 Thermal Interface Material

A Thermal Interface Material (TIM) provides improved conductivity between the IHS and heatsink. The reference thermal solution uses Honeywell PCM45 F*, 0.25mm (0.010 in.) thick, 20mm x 20mm (0.79 in. x 0.79 in.) square.

Note: Unflowed or “dry“ Honeywell PCM45F has a material thickness of 0.010 inch. The flowed or “wet“ Honeywell PCM45F has a material thickness of ~0.003 inch after it reaches its phase change temperature.

6.4.3.1 Effect of Pressure on TIM Performance

As mechanical pressure increases on the TIM, the thermal resistance of the TIM decreases. This phenomenon is due to the decrease of the bond line thickness (BLT). BLT is the final settled thickness of the thermal interface material after installation of heatsink. The effect of pressure on the thermal resistance of the Honeywell PCM45F TIM is shown in Table 6.1.

Intel provides both End of Line and End of Life TIM thermal resistance values of Honeywell PCM45F. End of Line and End of Life TIM thermal resistance values are obtained through measurement on a Test Vehicle similar to Intel® 3210 and 3200 Chipset’s physical attributes using an extruded aluminum heatsink. The End of line value represents the TIM performance post heatsink assembly while the End of Life value is the predicted TIM performance when the product and TIM reaches the end of its life. The heatsink clip provides enough pressure for the TIM to achieve End of Line thermal resistance of 0.345 °C inch^2/W and End of Life thermal resistance of 0.459 °C inch^2/W.

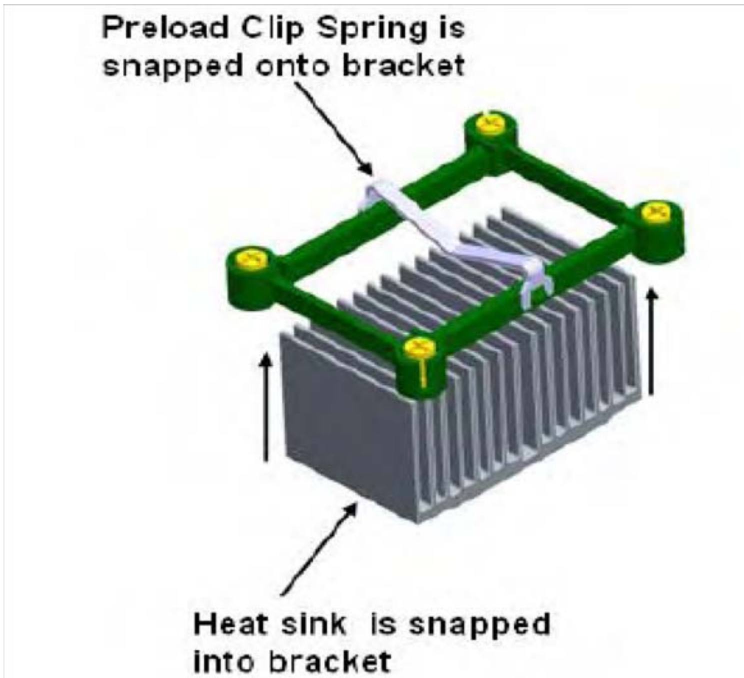
Table 6-1. Honeywell PCM45F* TIM Performance as a Function of Attach Pressure

Pressure on Psi	Thermal Resistance (°C x in^2) / W	
	End of Line	End of Life
2.18	0.391	0.551
4.35	0.345	0.459

6.4.4 Reference Thermal Solution Assembly Process

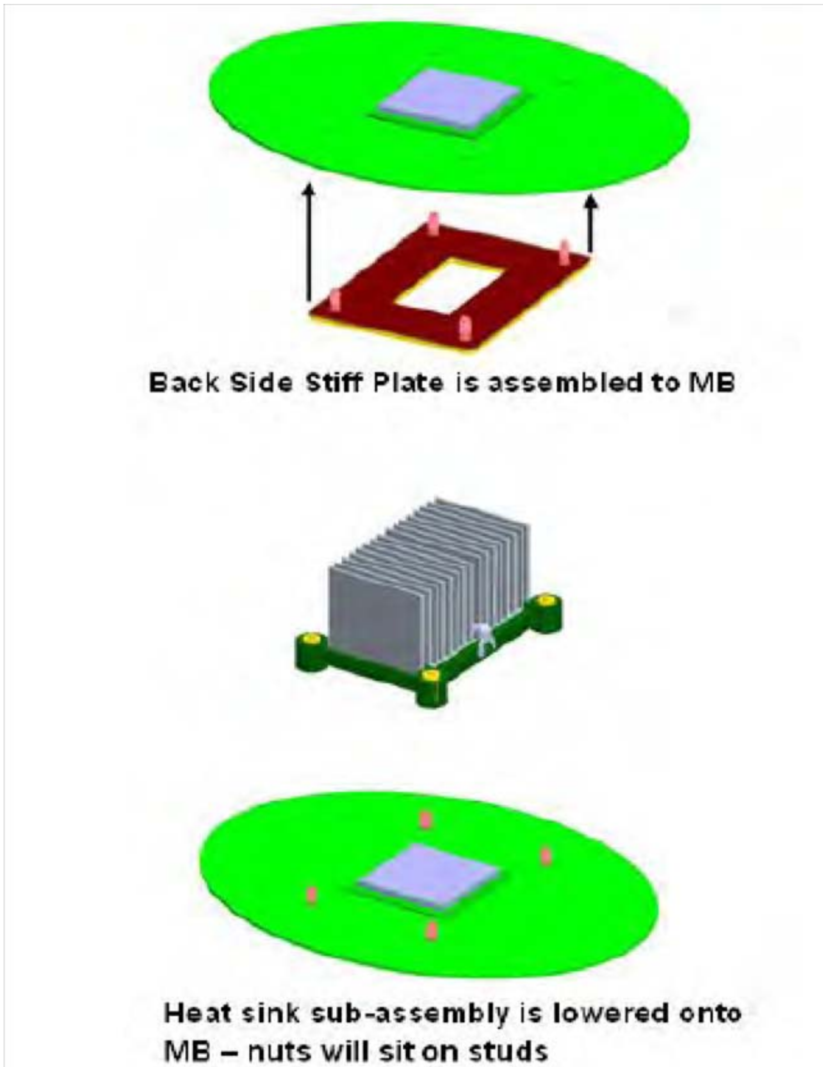
1. Snap the preload clip spring onto the bracket. Assemble the bracket with heatsink, as shown in Figure 6-4.

Figure 6-4. Reference Thermal Solution Assembly Process - Heatsink Sub-Assembly (Step 1)



2. Populate the backplate to the motherboard and align the nuts with the studs on the backplate, as shown in Figure 6-5.

Figure 6-5. Reference Thermal Solution Assembly Process - Heatsink Assembly (Step 2)



3. To assemble the heatsink with the backplate, screw in the nuts with 8 in-lb.

6.5 Reliability Guidelines

The environmental reliability requirements for the reference thermal solution are shown in Table 6-2. These should be considered as general guidelines. Each motherboard, heatsink and attach combination may vary the mechanical loading of the component. Based on the end-user environment, the user should define the appropriate reliability test criteria and carefully evaluate the completed assembly prior to use in high volume.

The testing will be performed with the sample board mounted on a test fixture. The test profiles are unpacked board level.

Table 6-2. Reference Thermal Solution Environmental Reliability Guidelines

Test [1]	Requirement	Pass/Fail Criteria [2]
Mechanical Shock	3 drops for + and – directions in each of 3 perpendicular axes Profile: 50 G, Trapezoidal waveform, 4.3 m/s [170 in/s] minimum velocity change	Visual Check and Electrical Functional Test
Random Vibration	Duration: 10 min/axis, 3 axes Frequency Range: 5 Hz to 500 Hz Power Spectral Density (PSD) Profile: 3.13 g RMS	Visual Check and Electrical Functional Test
Temperature Life	85 °C, 2000 hours total, checkpoints at 168, 500, 1000, and 2000 hours	Visual Check
Thermal Cycling	-40 °C to +70 °C, 50 cycles	Visual Check

Notes:
1. It is recommended that the above tests be performed on a sample size of at least twelve assemblies from three lots of material.
2. Additional pass/fail criteria may be added at the discretion of the user.

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A Thermal Solution Component Suppliers

A.1 Heatsink Thermal Solution

Part	Intel Part Number	Quantity	Contact Information
Heatsink Assembly	D96730-001		Monika Chih monika_chih@ccic.com.tw 886-2-29952666-1131
Heatsink	D96729-001	1	
Retainer	D92698-001	1	
Nuts-Inserts	D92621-001	4	
Bracket	E11663-001	1	
Stiffener-backplate	D94244-001	1	

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B Mechanical Drawings

The following table lists the mechanical drawings available in this document.

Figure B-1. Intel® 3210 and 3200 Chipset Package Drawing

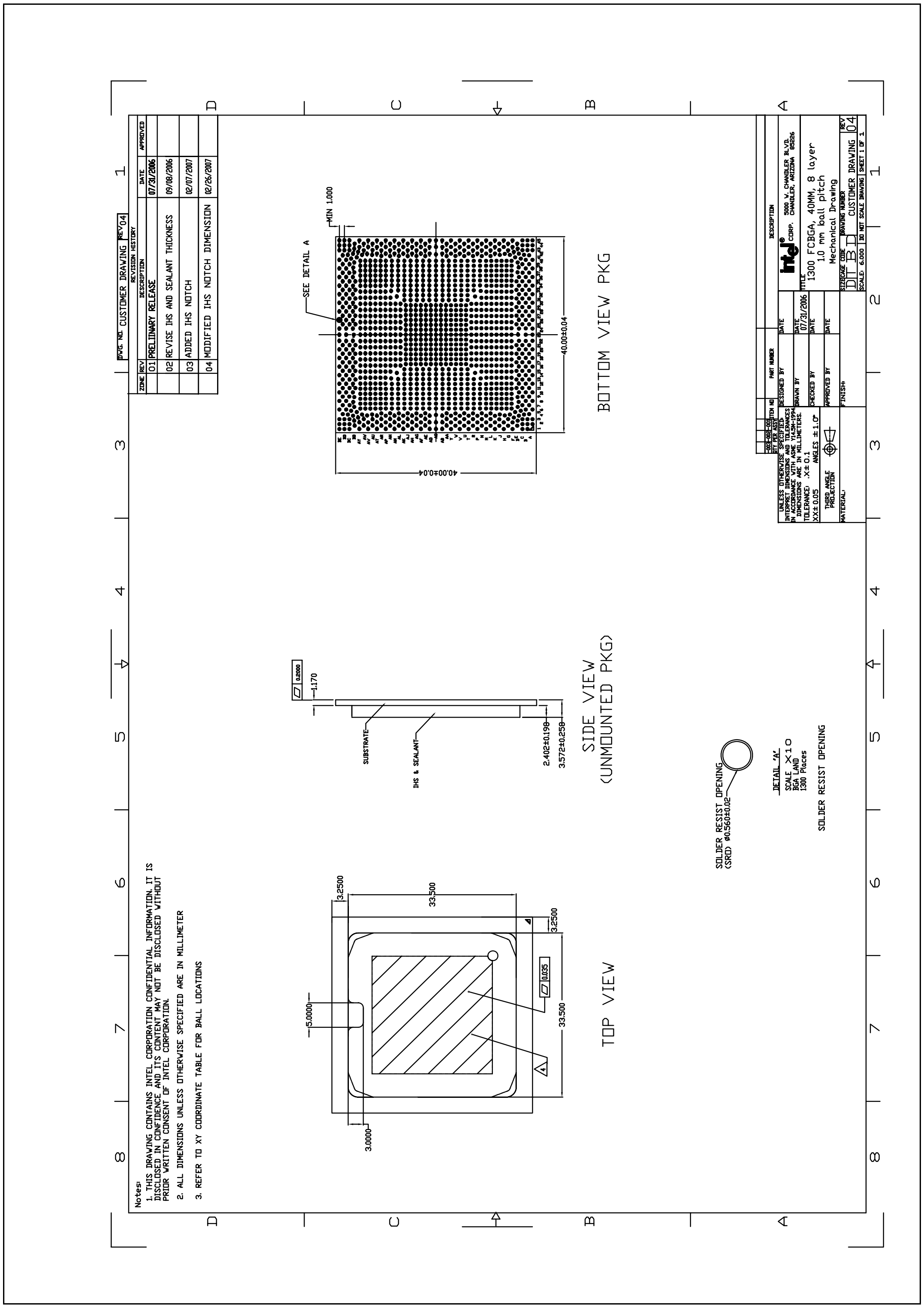


Figure B-2. Intel® 3210 and 3200 Chipset Motherboard Component Top-Side Keep-Out Restrictions

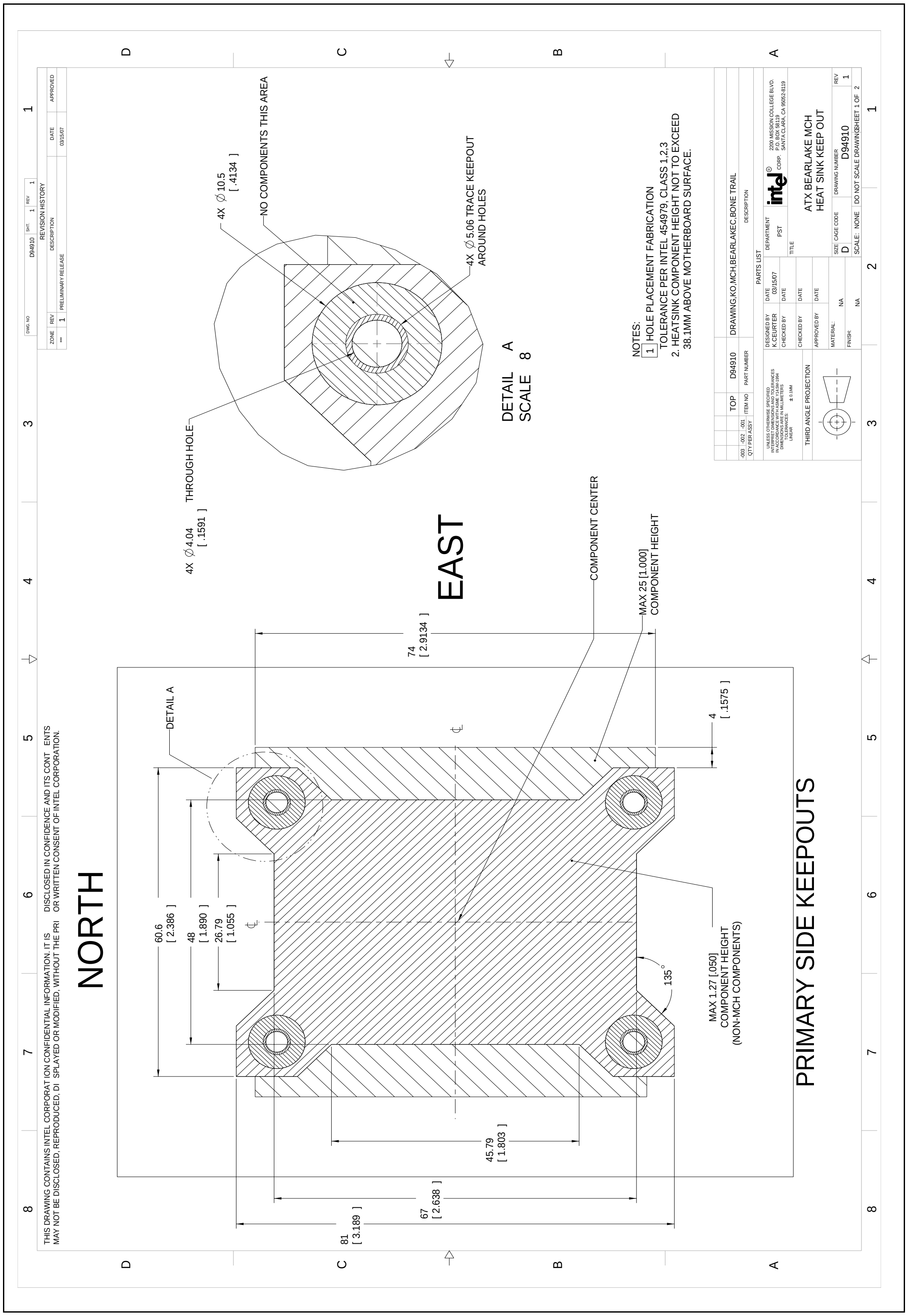


Figure B-3. Intel® 3210 and 3200 Chipset Motherboard Component Back-Side Keep-Out Restrictions

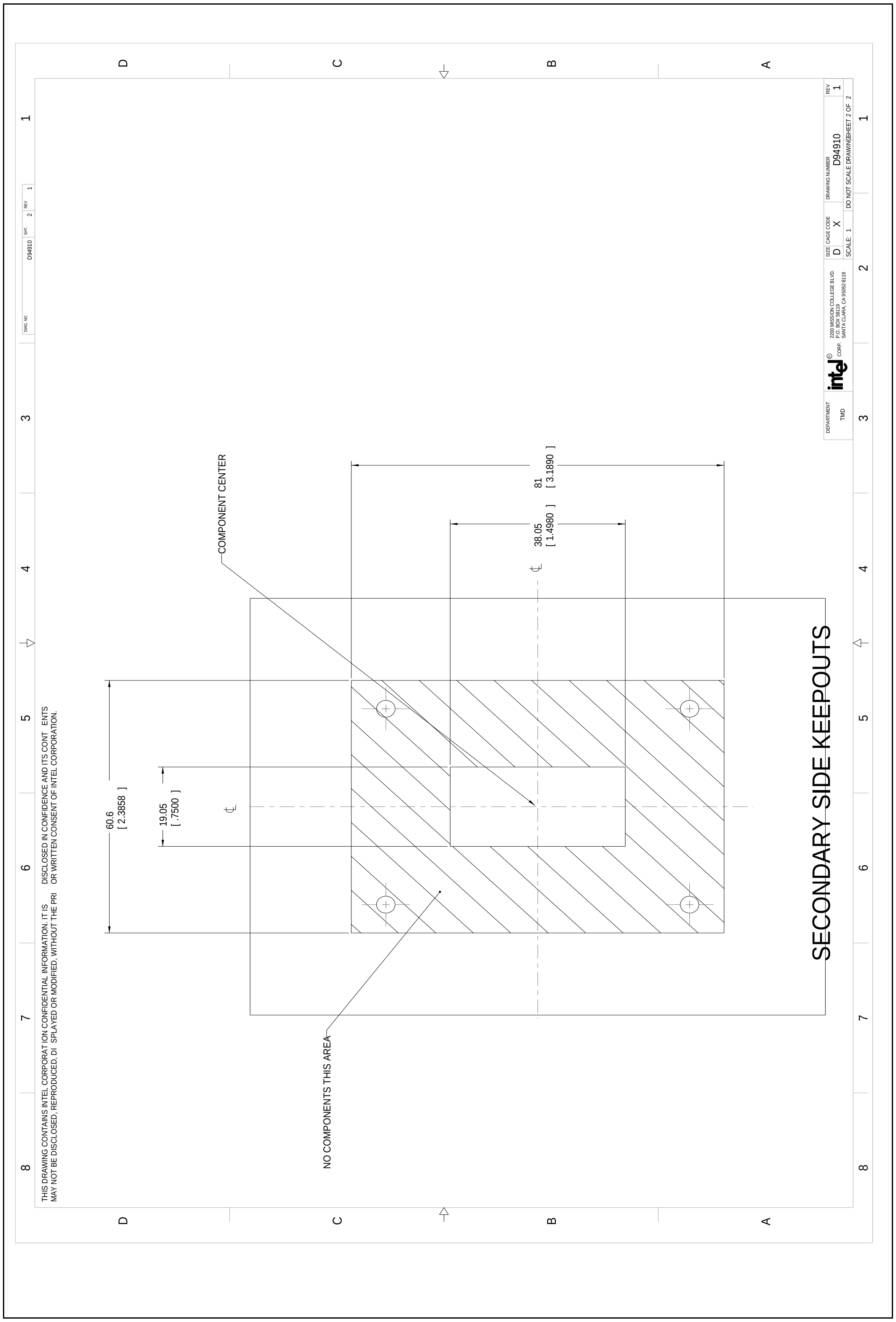


Figure B-4. Intel® 3210 and 3200 Chipset Reference Thermal Solution Assembly

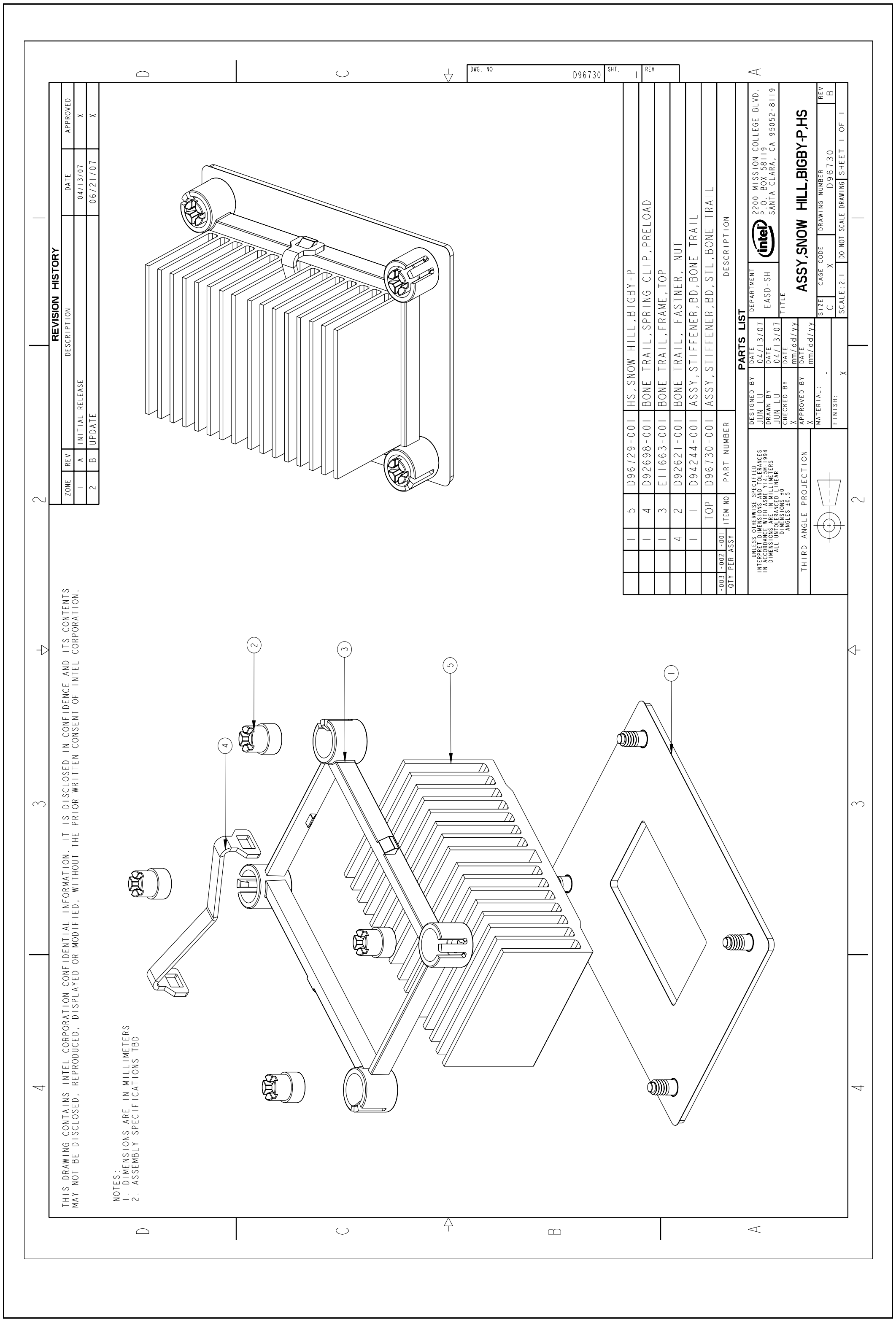


Figure B-5. Intel® 3210 and 3200 Chipset Reference Thermal Solution - Heatsink Drawing

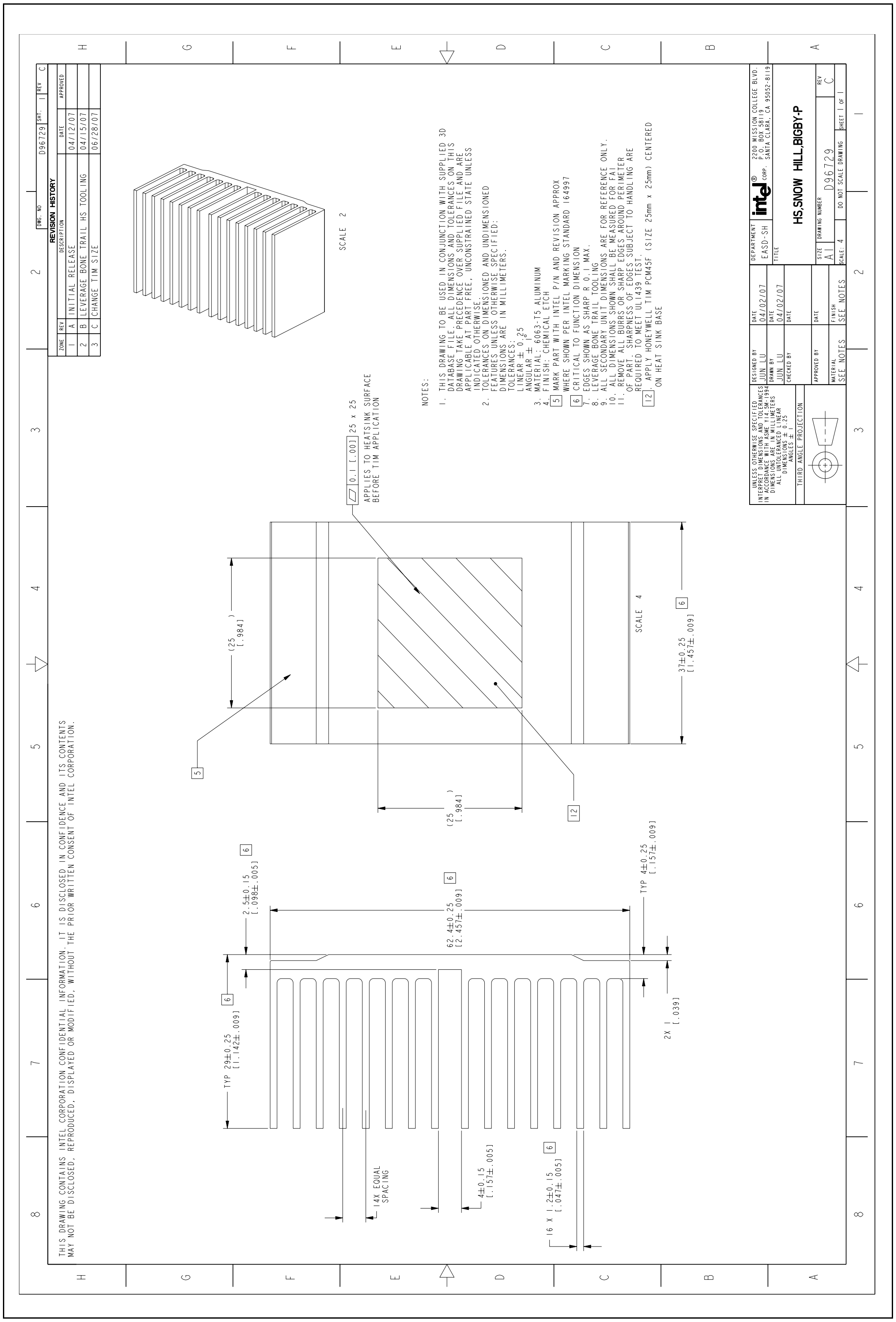


Figure B-6. Intel® 3210 and 3200 Chipset Reference Thermal Solution - Spring Preload Clip

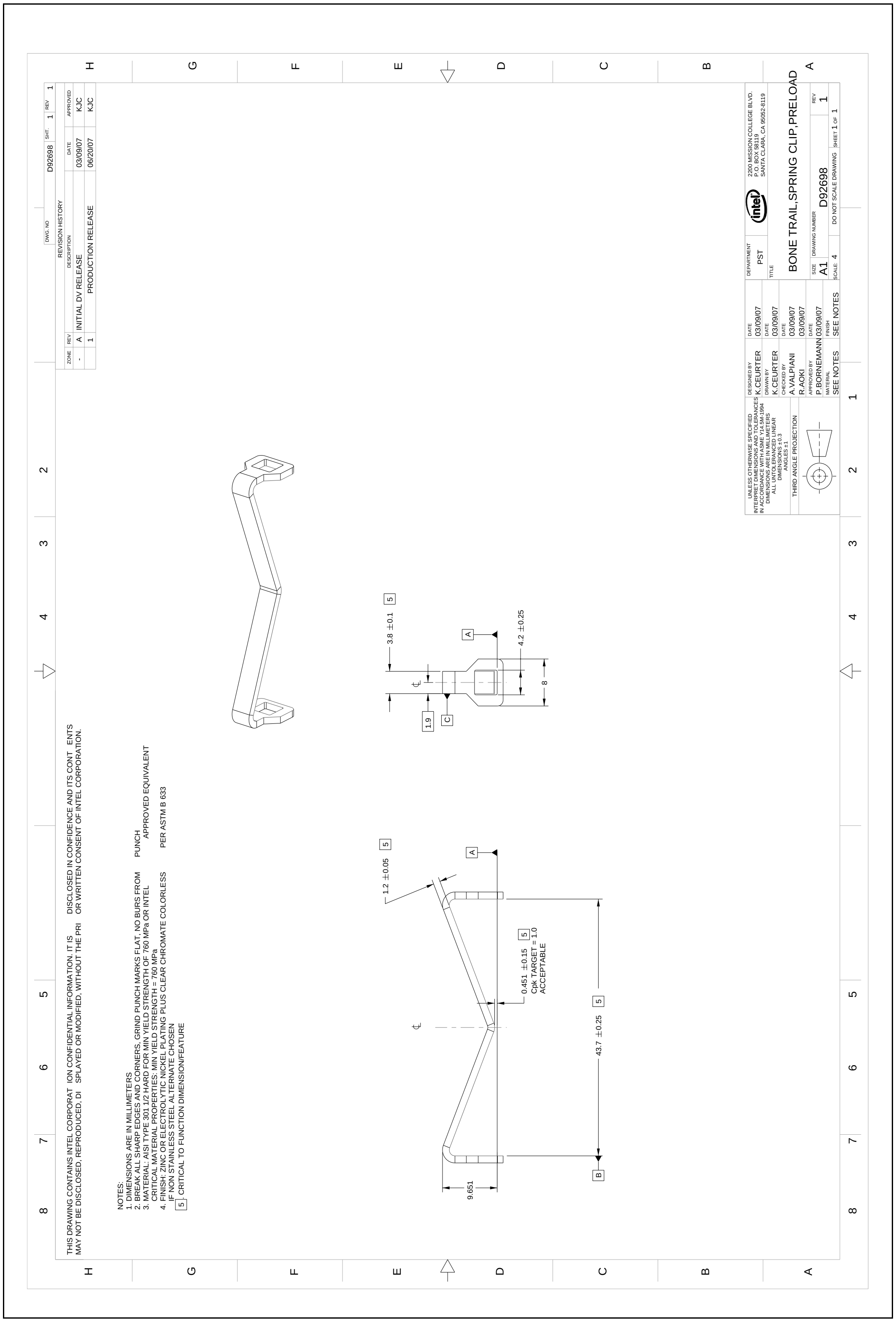


Figure B-7. Intel® 3210 and 3200 Chipset Reference Thermal Solution - Fastener Nut

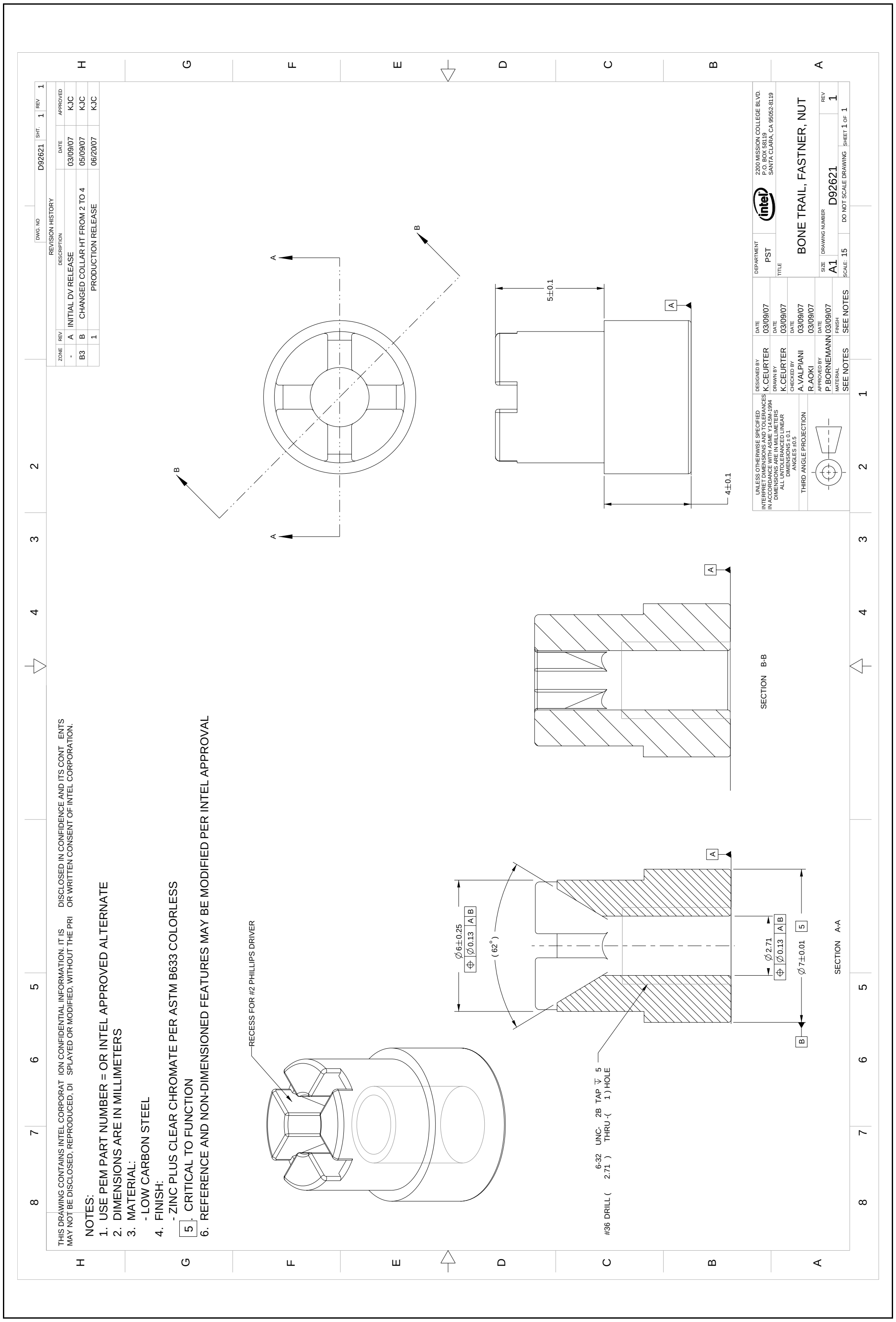


Figure B-8. Intel® 3210 and 3200 Chipset Reference Thermal Solution - Bracket (1 of 2)

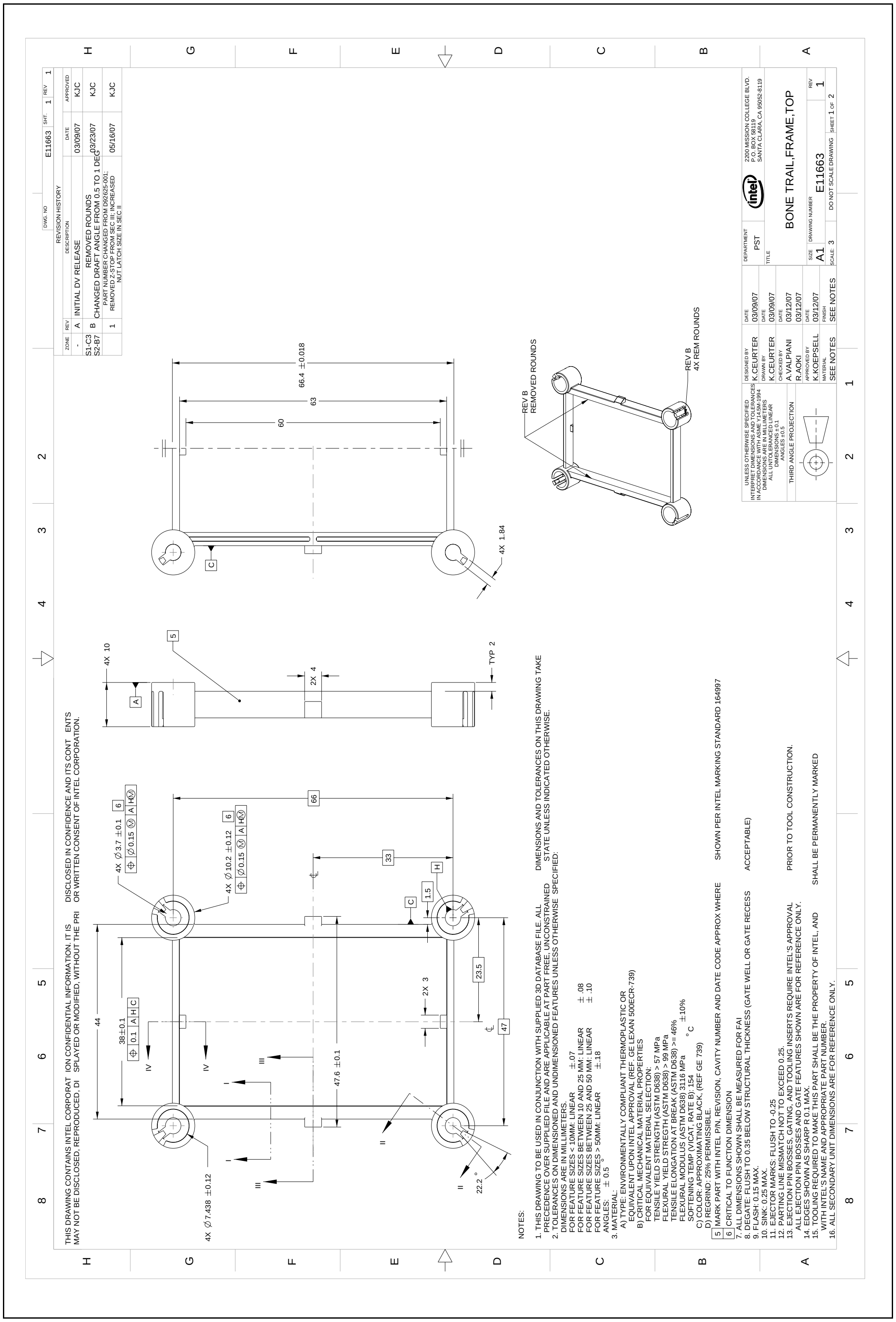


Figure B-9. Intel® 3210 and 3200 Chipset Reference Thermal Solution - Bracket (2 of 2)

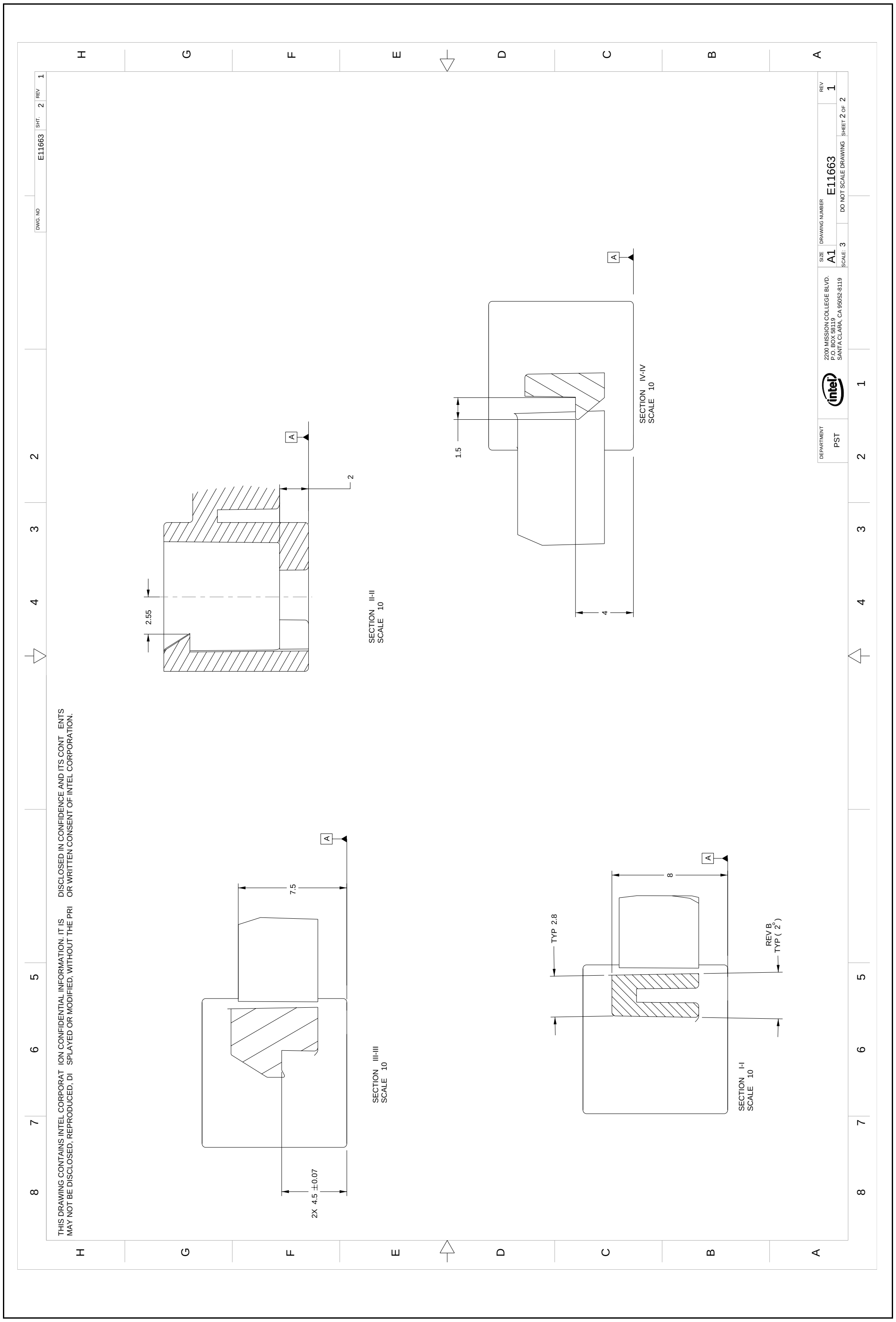


Figure B-10. Intel® 3210 and 3200 Chipset Reference Thermal Solution - Backplate Assembly

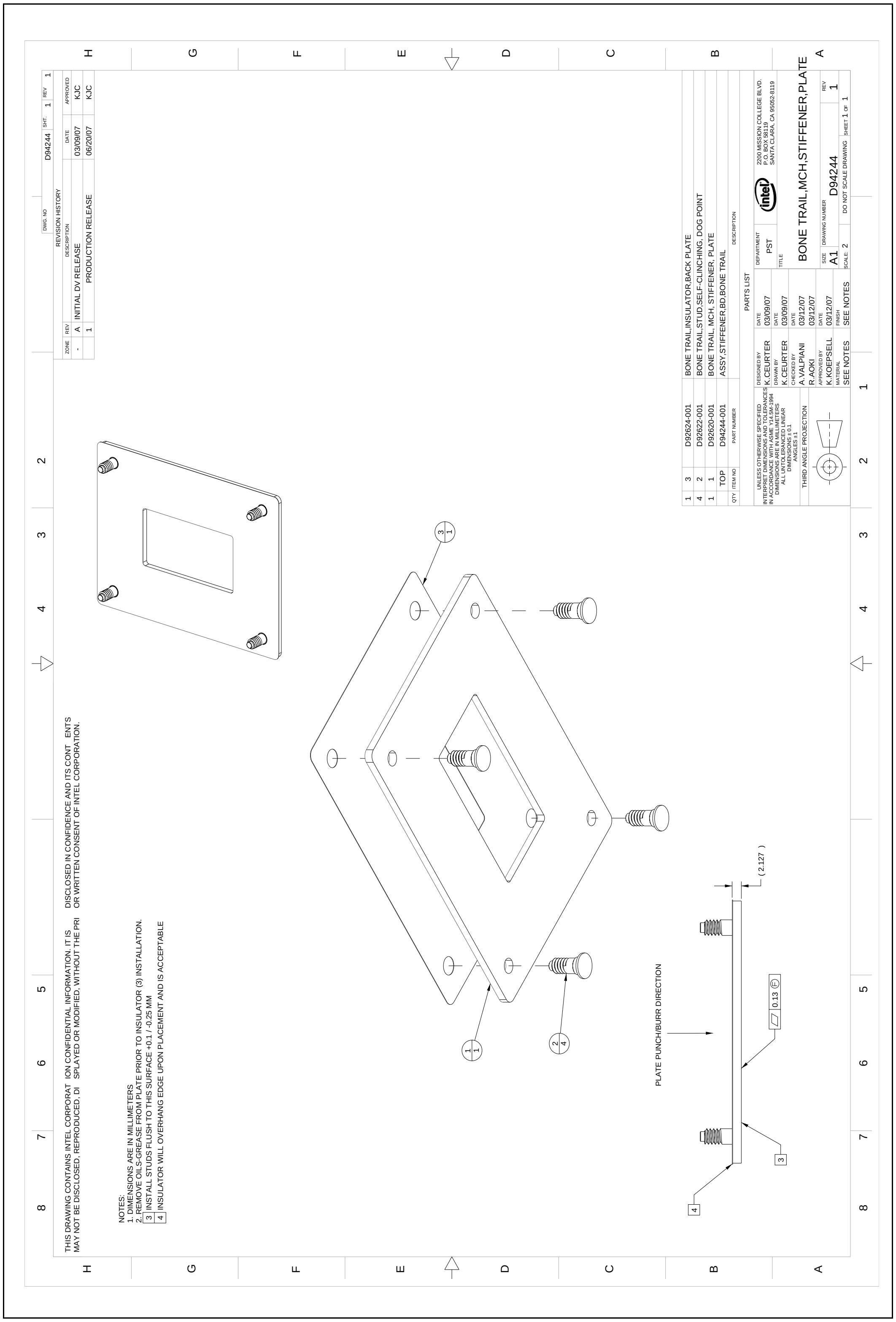


Figure B-11. Intel® 3210 and 3200 Chipset Reference Thermal Solution - Backplate

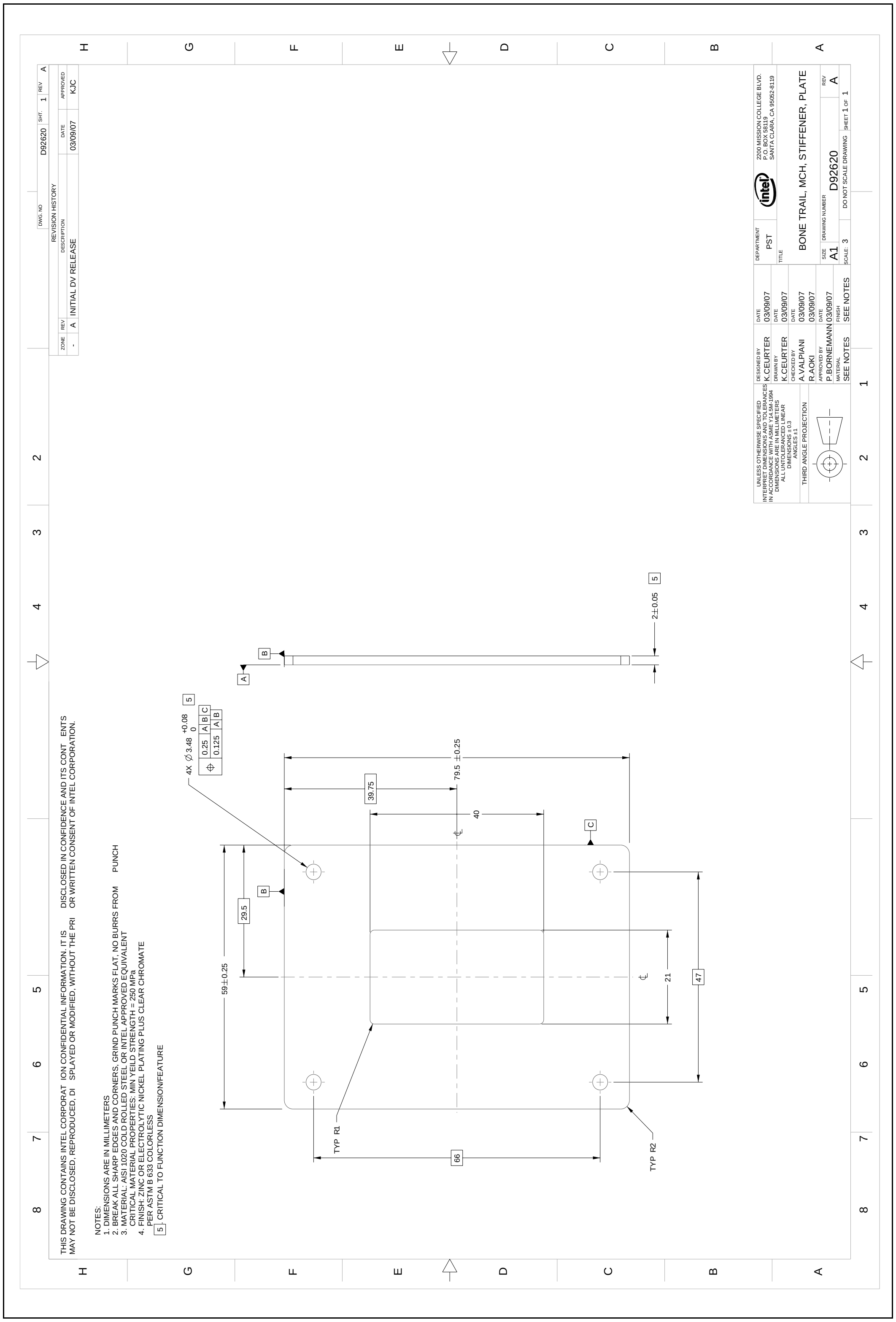


Figure B-12. Intel® 3210 and 3200 Chipset Reference Thermal Solution - Insulator

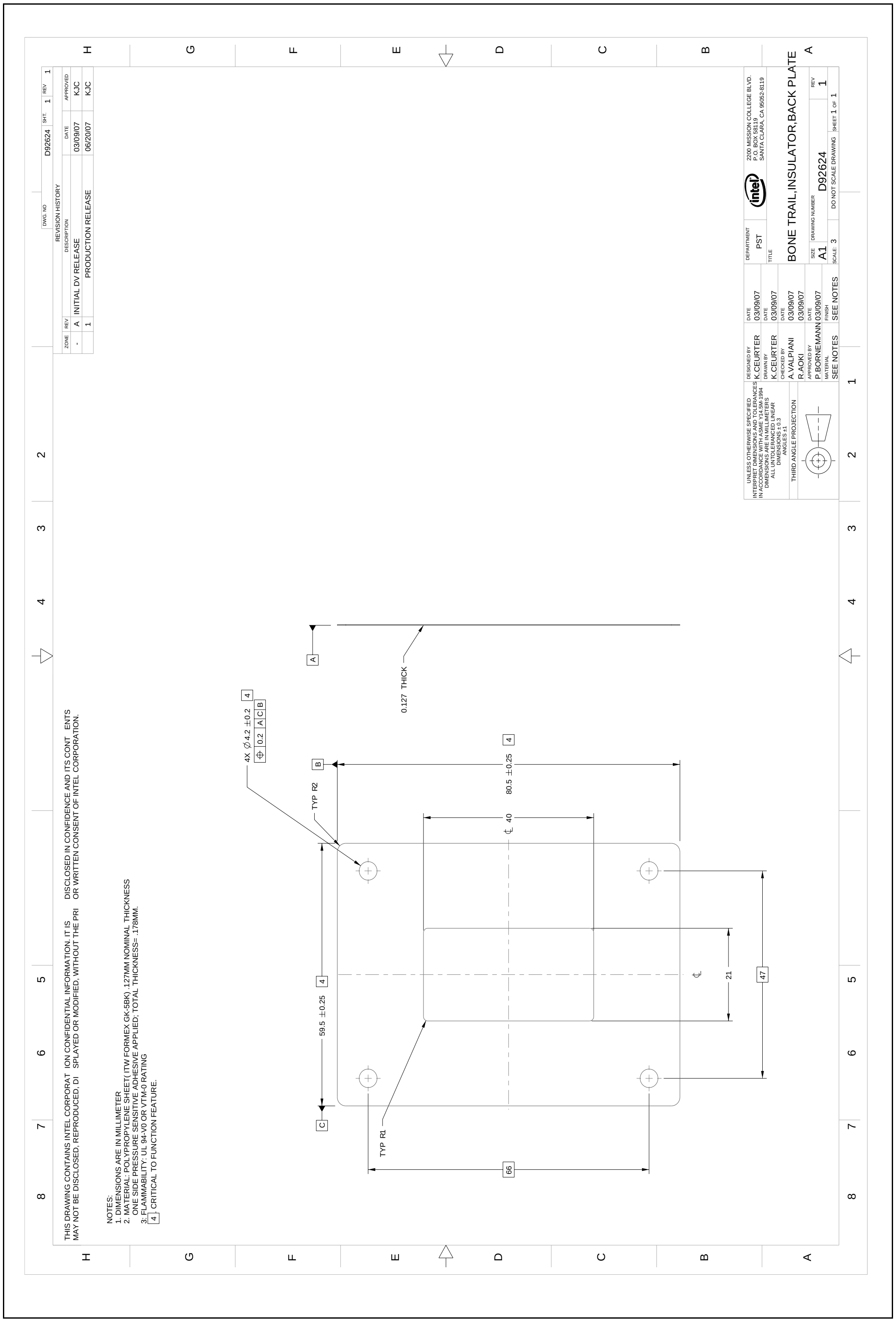
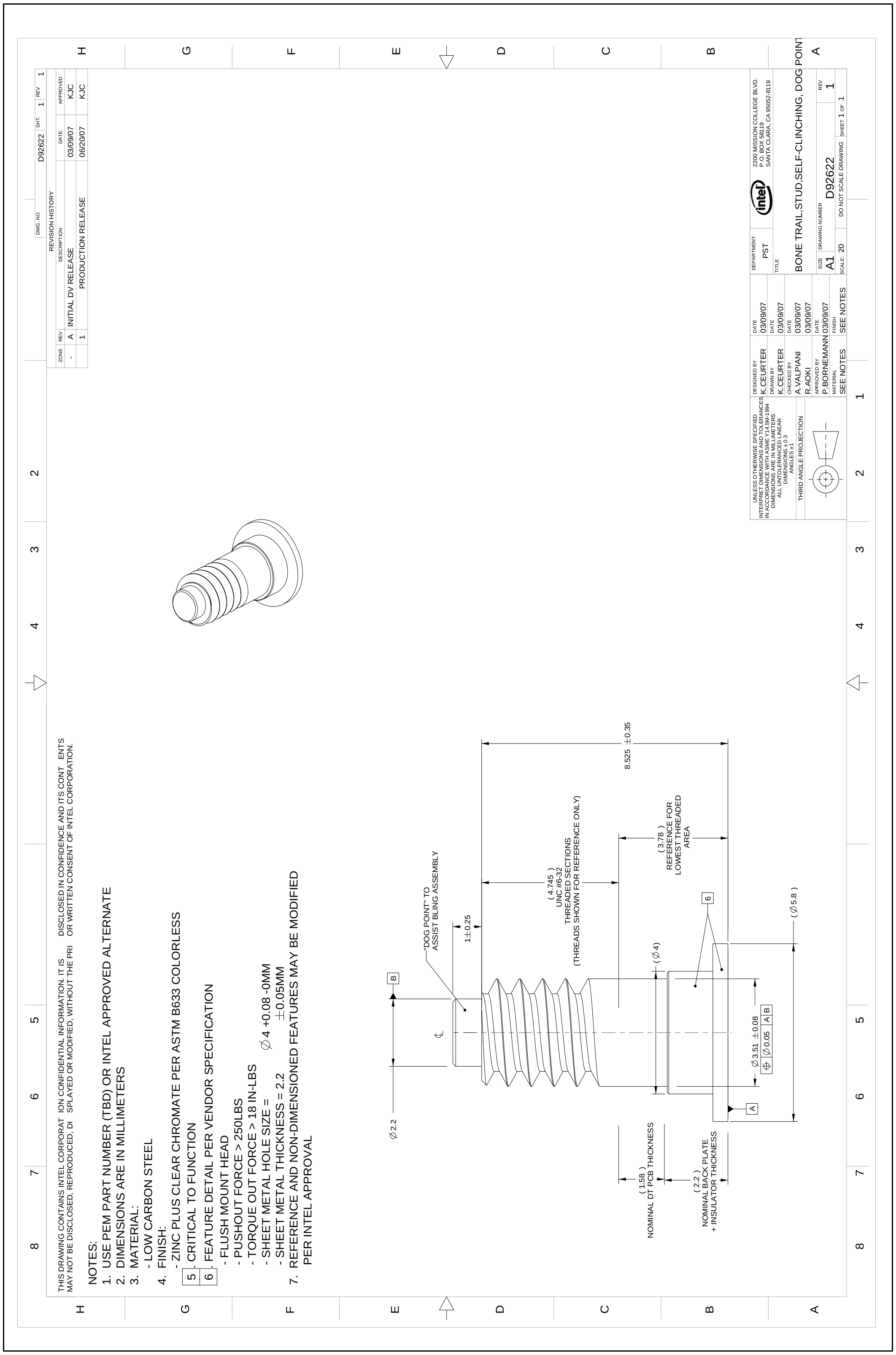


Figure B-13. Intel® 3210 and 3200 Chipset Reference Thermal Solution - Flush Mount Stud



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